SMITHSONIAN INSTITUTION LIBRARIES

SMITHSONIAN INSTITUTION LIBRARIES

90.693 B
59

Contents 1967

108

SMITHSONIAN
MAR 1 - 1969
LIBRARIES

No. 1. FEBRUARY

A Door to the Out-of-doors . . . *William G. Conway* 2
Ground Squirrels—"Picket-Pins" of Our Wild West . . . . *Frank F. Gander* 12
News from IRAB—Institute for Research in Animal Behavior . . *Robert A. Brown* 18
A New Zealand Oddity: The Flightless Takahe . . . . . *Dal Stivens* 20
An Indian Zoo Breeds an African Rhinoceros . . . . *John L. Miller* 26
In This Issue 28
Behind the Scenes 29
Illustration Credits 31
Publications of Interest 32

No. 2. APRIL

Baboons . . . . . *Patricia O'Connor* 34
The Thornbird and Its Many-chambered Nest . *Alexander F. Skutch* 44
Focusing on Zoo Animals *Photographs by Paul G. Kovac* 52
Rarest of North American Turtles . . . . . *Arsene Eglis* 58
In This Issue 62
Behind the Scenes 63
Illustration Credits 64
Publications of Interest 64

No. 3. JUNE

Malagasy Lemurs —Clues to Our Past . . . . . *Alison Jolly* 66
Animal Kingdom Reports 76
Would You Believe— The Kiwi? . . . . . *Dal Stivens* 78
Olms—Of Such Are Legends Made . . . *Brother G. Nicholas, F.S.C.* 84
"Pride's Progress" *Review by John Miller* 88
Mixing It Up in Brookfield's Reptile House . *Raymond L. Pawley* 90
The Bookshelf 96
About the Authors 96
Illustration Credits 96

No. 4. AUGUST

Rhinos, Whirlybirds and M99 . . . . . *N. J. Russell* 98
Golden-naped Woodpecker . . *Alexander F. Skutch* 106
Argentine Fauna: Time of Decision . . . *Fernando Nottebohm* 112
Animal Kingdom Reports 119
Endangered! . . . . . *Peter Brazaitis* 122
The Bookshelf 128
Letters to the Editor 128
About the Authors 128
Illustration Credits 128

No. 5. OCTOBER

Wildlife Fights for Survival . . . . . *Stewart L. Udall, United States Secretary of the Interior* 130
The Everglades: Ecological Puzzle (Part I) . . . . *William M. Partington* 134
Wolf—Victim of Calculated Slaughter . . . . . *John Hillaby* 142
Report from Ruaha . . . . *Royal Little* 146
Quest for the White Whale— The New York Aquarium Brings Back Two Belugas . . . *Edward R. Ricciuti* 148
Animal Kingdom Reports 157
The Bookshelf 160
About the Authors 160
Illustration Credits 160

No. 6. DECEMBER

The Everglades: Ecological Puzzle (Part II) . . . . *William M. Partington* 162
Hyenas: Facts and Fancy . . . . . *Patricia O'Connor* 173
Shark Attacks . . . . *William J. Cromie* 180
Camera Safari . . . . *Elysbeth Wyckoff* 186
Animal Kingdom Reports 190
The Bookshelf 192
About the Authors 192
Illustration Credits 192

Index 1967

Figures in **bold type** indicate that the reference is to, or includes, an illustration, map, or design.

A

aardvark, first born in captivity in Western Hemisphere, **190-191**
Aepyornis, 23
alligator, American, 123, **125, 141**
Chinese, **90, 126-127**
tagging of, **167**
Alligator mississippiensis, 123, **125**
sinensis, **126-127**
Apteryx australis, **78**, 80
Argentina, map of, **114**
Argentine fauna
destruction of, **112-118**
aoudads, **54**
armadillo, giant, **114-115**
six-banded, **114-115**

B

baboon, **34-43**
chacma, 41, **42**
drill, 36-37, **40**
gelada, **39-41**
hamadryas, 37-38, **40**
mandrill, 35, **36, 37**, 41
olive, 41, **42, 43**
western, or guinea, 41
yellow, **34-35**, 41-42, 43
bison, American, **132**
Books reviewed:
"The Alien Animals," 64
"Animals of the North," 32
"Auf Safari in Europa," 64
"Basic Microscopic Techniques," 128
"The Bird: Its Form and Function," 32
"Bird Studies at Old Cape May," 32
"Birds of North America," 32
"The Deer and the Tiger," 64
"Horseshoe Crab," 96
"The Imperial Collection of Audubon Animals," 160
"The Living World of the Sea," 192
"The Mammals of Eastern Canada," 128
"Man and Pandas," 32
"The Mighty Bears," 64
"Pride's Progress," 89
"Sharks, Skates and Rays," 192
"Small Mammals Are Where You Find Them," 32
"Social Communication Among Primates," 96
"The Watcher at the Nest," 128
"The World of the Polar Bear," 32
"The World of the Porcupine," 32
"The World of the Woodchuck," 32
Brazaitis, Peter
"Endangered!," 122-127
Brookfield Zoo, reptile house, 90-95
Brown. Robert A., 28
"News from IRAB — Institute for Research in Animal Behavior," 18-19
Budinger, Dr. John M., 63

C

Caiman crocodilus, 125, **127**
camel, North African, **188**
Canis lupus, **142**, 143, **145**
capybara, **114-115**
Carcharhinus leucas, **182**
cat, flat-headed, 64
Ceratotherium simum, 26, 27, 31, **57**
chachalaca, **133**
Chamarajendra Zoological Gardens, 26-27
chameleon, African, **31**
cheetah, **147**
Citellus beecheyi, **13**, 14, **16-17**
beldingi, 13-14, 16
franklini, 16
harrisi, 16-17
lateralis, 12, **14**, 16
leucurus, 16
nelsoni, 16
parryi, 16
richardsoni, 13
spilosoma, 13
tridecemilineatus, 13, **17**
variegatus, 16
Clemmys muhlenbergi, **58-61**
cobra, king, **95**
Comopithecus hamadryas, 37-38, **40**
condor, California, 77
Conway, William G., **11**, 28
"A Door to the Out-of-Doors," 2-11
cormorant
African white-crested, **55**
guanay, 2-3
cottonmouth, **137, 170**
crane, whooping, **130-132**, 133
crocodile, American, **124**
caiman, black, **124, 125**
South American, 125, **127**
Cuban, **122**, 124-125
Morelet's, **124**
Nile, 124, **125-126**
Crocodylus moreletii, **124**
niloticus, 124, **125-126**
rhombifer, **122**, 124-125
Crocuta crocuta, 174, **175-177, 178**
Cromie, William J.
"Shark Attacks," 180-185

D

deer, Japanese sika, **188**
Diceros bicornis, **26-27**, 31, **52, 147**
Didermocerus sumatrensis, 31
sumatrensis lasiotis, 31
sumatrensis sumatrensis, 31
Dionornis maximus, 23

E

echidna, birth, **119-120**
Eglis, Arsene, 62
"Rarest of North American Turtles," 58-61
egret, cattle, **57**
common, **137**
elephant, African, **189**
Asian, **52**
elk, **132**
Endangered Species Preservation Act, 132
The Everglades, **134-141**, **162-172**
exhibits
bird, **2-11**
future, 63
mixed, **90-95**

F

Felis, planiceps, 64
finch, saffron, **51**
flamingo, **6-7, 10-11**
photo of, contest winner, 30
flycatcher, fire-crowned, **51**
piratic, **51**
fox, Patagonian grey, **117**

G

Gander, Frank F., 28
"Ground Squirrels - 'Picket-Pins' of Our Wild West," 12-17
gibbon, white-handed, **cover 4, 97**
gorrilla, baby twins, **cover 3, 65, 76**
Gowda, C. D. Krishne, 26-27
guanaco, **112-113**, 115
guidebook, Milwaukee Zoo, 77
gull, herring, longevity record, 121

H

Haas, Emmy
photographs by, 88-89
review of book by, 89
Hapalemur griseus, 70
heron, black-crowned, **164**
Hillaby, John
"Wolf—Victim of Calculated Slaughter," 142-145
House, Brad, 28, 33
hummingbird, Caribbean emerald-throated, 9
Hyaena brunnea, 174, **177**
hyaena, **174-175**
hyena, **173-179**
brown, 174, **177**
spotted, **76-77**, 174, **175-177, 178**
striped, **174-175**

I

ibis, scarlet, **157**
wood, 164-166
iguana, green, **90**
marine, **92**

Institute for Research in Animal Behavior, 18-19

J

jaguar, 52, 112, 113, 116-117
Jolly, Alison
"Malagasy Lemurs—Clues to Our Past," 66-75

K

kangaroo, slaughter, 120
Kenya Game Department, 98-105
kite, Everglades, 166
kiwi, 78-83
Kovac, Paul G., 28, 62
photographs by, cover 1, 3, 52-55

L

Lama guanicoe, 112-113, 115
lemur, 66-75
gentle, 70
indri, 70, 71
ringtail, 66-68, 70-75, 77
sifaka, coquerel, 71
diademed, 70
white, 71-74
Lemur catta, 66-68, 70-75, 77
leopard, snow, 29-30
spotted, 29
letters-to-the-editor, 63, 128
Liguus fasciatus, 166
lion, 88-89
Little, Royal
"Report from Ruaha," 146-147
lizard, basilisk, 94

M

M99, 98-105
mamba, green, 92
Mandrillus sphinx, 35, 36, 37, 41
marine conference, 158-159
Melanosuchus niger, 124, 125
Meng, William, 62
photographs by, cover 2, cover 5
Mikumi National Park, 63
Miller, John L.
"An Indian Zoo Breeds an African Rhinoceros," 26-27, 31
review by, "Pride's Progress," 89
moa, 23
monkey, red howler, cover 2, 33
Morris, Robert, 149-153

N

National Wildlife Refuge System, 130-133
nests, many-chambered, 44-51
New Zealand, map of, 79
Nicholas, Brother G., F.S.C.
"Olms—Of Such Are Legends Made," 84-87
Nigrelli, Dr. Ross F., 158
Notornis mantelli, 20-25
Nottebohm, Fernando
"Argentine Fauna: Time of Decision," 112-118

O

O'Connor, Patricia, 62
"Baboons," 34-43
"Hyenas: Facts and Fancy," 173-179
olm, 84-87
orang-utan, 77
Orbell, Dr. G.B., 21-23
Orycteropus afer, 190-191
Osborn, Fairfield, 157, 190
Osborn Laboratories of Marine Sciences, 157-158
owl, barn, 120-121

P

palm-chat, 51
Panthera tigris, 121
Papio cyanocephalus, 34-35, 41-42, 43
doguera, 41, 42, 43
papio, 41
ursinus, 41, 42
parakeet, gray-crested, 51
Partington, William M.
"The Everglades: Ecological Puzzle," Part I, 134-141
Part II, 162-172
Pavo cristatus, cover 1, 1
Pawley, Raymond L
"Mixing It Up in Brookfield's Reptile House," 90-95
peacock, Indian, cover 1, 1
pelican, 6-7
dalmation, 52, 56
eastern brown, 171
penguin, Adelie, 19
Phacellodomus rufifrons, 44-51
Pituophis, 17
Porphyrio porphyrio melanotus, 21, 23, 24
Priodontes giganteus, 114-115
Propithecus diadema, 70
verreauxi coquereli, 71
verreauxi verreauxi, 71
protection of wildlife, 130-133
Proteus anguinus, 84-87
pukeko, 21, 23, 24

R

Rainey Memorial Gate
designated landmark, 29
rattlesnake, western diamondback, 91, 190, 191
rhea, 113, 115, 118
Darwin's, 113
rhinoceros, African black, 26-27, 31, 52, 98-105, 147
African white, or square-lipped, 26, 27, 31, 57
captive-bred, 28
Indian (one-horned), 31
Javan, 31
two-horned
hairy-eared, 31
Sumatran, 31
Rhinoceros sondaicus, 31
unicornis, 31
Ricciuti, Edward R.
"Quest for the White Whale—The New York Aquarium Brings Back Two Belugas," 148-156
Ruaha National Park, 146-147
Russell, N. J.
"Rhinos, Whirlybirds and M99," 98-105

S

salamander, cave, 84-87
Sandford, Lloyd, 62
illustrations by, 44, 48-49, 50, 51, 106-111
sea elephants, 117
sea lions, 117
shark, 180-181
lemon, 183
tiger, 185
shark attacks, 180-185
Skutch, Alexander F., 62
"Family Life of the Golden-naped Woodpecker," 106-111
"The Thornbird and Its Many-chambered Nest," 44-51
Small Mammal House, Philadelphia, 77
snail, tree, 166
snake, gopher, 17
squirrel, ground, 12-17
antelope, 16-17
San Joaquin, 16
whitetailed, 16
Yuma, 16-17
Arctic, 16
Belding, 13-14, 16
California, 13, 14, 16-17
Franklin, 16
golden-mantled, 12, 14, 16
Richardson, 13
rock, 16
spotted, 13
thirteen-lined, 13, 17
Stivens, Dal, 28
"A New Zealand Oddity: The Flightless Takahe," 20-25
"Would You Believe—The Kiwi?," 78-83
swamp hen, 21, 23, 24

T

takahe, 20-25
tanager, blue, 50
sayaca, 50
tapir, 114-115
teal, Laysan, 11
Theropithecus, 39-41
thornbird, rufous-fronted, 44-51
tiger, Siberian, 121
travel guide maps: inside back cover
National Zoological Park, Washington, D.C., 3
John G. Shedd Aquarium, Chicago, 4
Swope Park Zoo, Kansas City, Mo., 6
Woodland Park Zoological Gardens, Seattle, 5
Tripsurus chrysauchen, 106-111
troupial, 48-49, 50
turtle, alligator snapping, 93
bog, 58-61

U

Udall, Stewart L., U.S. Secretary of the Interior
"Wildlife Fights for Survival," 130-133

V

viper, gaboon, 90
vulture, turkey, 170

W

walrus, "Olaf," 30
waterbuck, 147
weaverbird, social, 51
whale, beluga, 148-156
wolf, gray, 142, 143, 145
red, 143
Labrador, 144
slaughter of, 142-145
woodpecker, golden-naped, 106-111
ivory bill, 159
Wychoff, Elysbeth
"Camera Safari," 186-189

Z

zebra, Grevy's, 53
zoo poster, 30-31

590.673
A59

VOL. LXX, NO. 1, FEBRUARY, 1967

SMITHSONIAN
APR 3 1967

animal kingdom

animal

MAGAZINE OF THE NEW YORK ZOOLOGICAL SOCIETY

CONTENTS

A Door to the Out-of-doors, 2
By William G. Conway

Ground Squirrels — "Picket-pins" of Our Wild West, 12
By Frank F. Gander

News from Irab — Institute for Research in Animal Behavior, 18
By Robert A. Brown

A New Zealand Oddity: The Flightless Takahe, 20
By Dal Stivens

An Indian Zoo Breeds an African Rhinoceros, 26
By John L. Miller

In This Issue, 28

Behind the Scenes, 29

Illustration Credits, 31

Publications of Interest, 32

Issued bi-monthly by the New York Zoological Society at the Zoological Park, Bronx, N. Y. 10460. Editorial and Subscription Offices at the same address. Title registered with the U. S. Patent Office. Subscription, $3.50 a year; single copy, 60 cents. Same rates for all foreign countries and Canada. Second-class postage paid at Bronx, N. Y. Send Form 3579 to Bronx, N. Y. 10460.

kingdom

VOL. LXX • NO. 1 • FEBRUARY, 1967

ABOUT THE COVER

Late-February through early-June is the time to see the Bronx Zoo's free-roaming Indian Peacocks in their magnificent courtship display. Although they are not confined to any exhibit area, the species (*Pavo cristatus*) is very much part of the collection and a count is made at the end of each year. The census generally averages between 20 and 30 specimens. (The 1966 figure was 27 birds.)

The peacock train is often called a "tail," but the true tail is short and stiff and acts as support for the train when it is displayed. Peahens nest in secluded areas of the Zoo, laying from two to six eggs a year. The chicks are hatched from June to August and can often be observed with their mothers.

Their presence dates back before 1909, the year General Curator Emeritus Lee Crandall came to work at the Zoo. Mr. Crandall recalled recently that the peafowl were already established at the time.

For more on the cover see page 28.

NEW YORK ZOOLOGICAL SOCIETY
630 Fifth Avenue, New York, N. Y. 10020

President
Fairfield Osborn

First Vice-President;
Chairman, Executive Committee
Laurance S. Rockefeller

Vice-President
Henry Clay Frick, II
Robert G. Goelet

Secretary
John Elliott

Treasurer
David Hunter McAlpin

Assistant Treasurer
Eben W. Pyne

BOARD OF TRUSTEES
(*Executive Committee**)
Alexander Aldrich, George F. Baker, Jr.*, Robert E. Blum, William R. Coe, C. Suydam Cutting, John Elliott*, Charles W. Engelhard, Henry Clay Frick, II*, Robert I. Gannon, Peter R. Gimbel*, Robert G. Goelet*, Peter Grimm, John N. Irwin, II*, Warren Kinney, Anthony D. Marshall, Otto Marx, Jr., David Hunter McAlpin*, Peter Matthiessen, G. W. Merck, Charles W. Nichols, Jr., Fairfield Osborn*, Augustus G. Paine, II, Howard Phipps, Jr., John H. Phipps, John Pierrepont*, Eben W. Pyne, Laurance S. Rockefeller*, David T. Schiff, John M. Schiff, Henry Sears, Chauncey Stillman, Joseph A. Thomas, Landon K. Thorne, Jr., Alfred G. Vanderbilt, Robert Winthrop.

Ex-Officio:
The Mayor of the City of New York, Hon. John V. Lindsay
Administrator of Recreation and Cultural Affairs, August Heckscher

General Director
William G. Conway
John Tee-Van, *Emeritus*

ZOOLOGICAL PARK
William G. Conway, *Director & Curator of Birds;* Charles P. Gandal, *Veterinarian;* Hugh B. House, *Assistant Curator, Mammals;* Grace Davall, *Assistant Curator, Mammals & Birds;* Joseph Bell, *Associate Curator, Birds;* Herndon G. Dowling, *Curator, Reptiles;* Herbert J. Knobloch, *Curator, Education;* Charles B. Driscoll, *Superintendent, Operations;* Edward Kearney, *Manager, Facilities Dept.;* Lee S. Crandall, *Zoological Park Consultant & General Curator Emeritus;* Roland Lindemann, *Consultant, Mammal Management.*

AQUARIUM
Ross F. Nigrelli, *Director;* Robert A. Morris, *Associate Curator;* Jewell Bungay, *Business Manager;* Louis Mowbray, *Research Associate, Field Biology;* Christopher W. Coates, *Director Emeritus.*

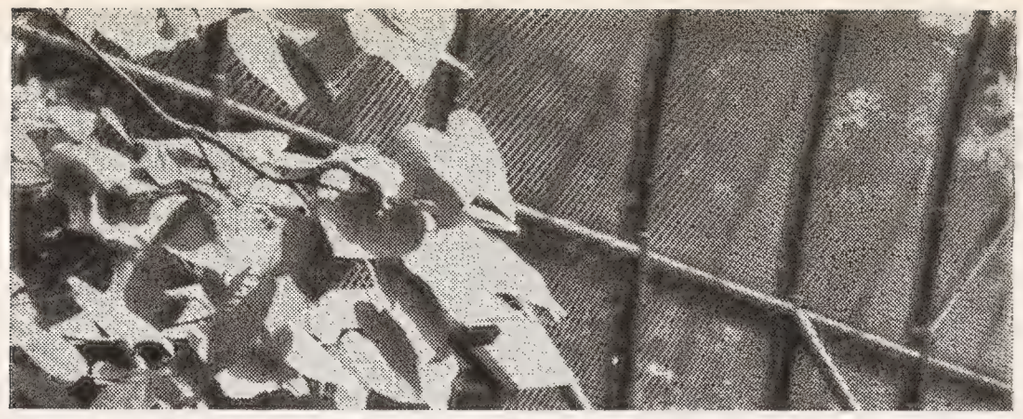
OSBORN LABORATORIES OF MARINE SCIENCES
Ross F. Nigrelli, *Director & Pathologist;* Martin F. Stempien, Jr., *Assistant to the Director;* Klaus Kallman, *Geneticist.*

INSTITUTE FOR RESEARCH IN ANIMAL BEHAVIOR
(Operated jointly by the Society & Rockefeller University)
Donald R. Griffin, *Director;* Peter R. Marler, Jocelyn Crane, Roger S. Payne, Richard L. Penney, Fernando Nottebohm, George Schaller, Thomas T. Struhsaker, C. Alan Lill, O. Marcus Buchanon, *Resident Director, William Beebe Tropical Research Station.*

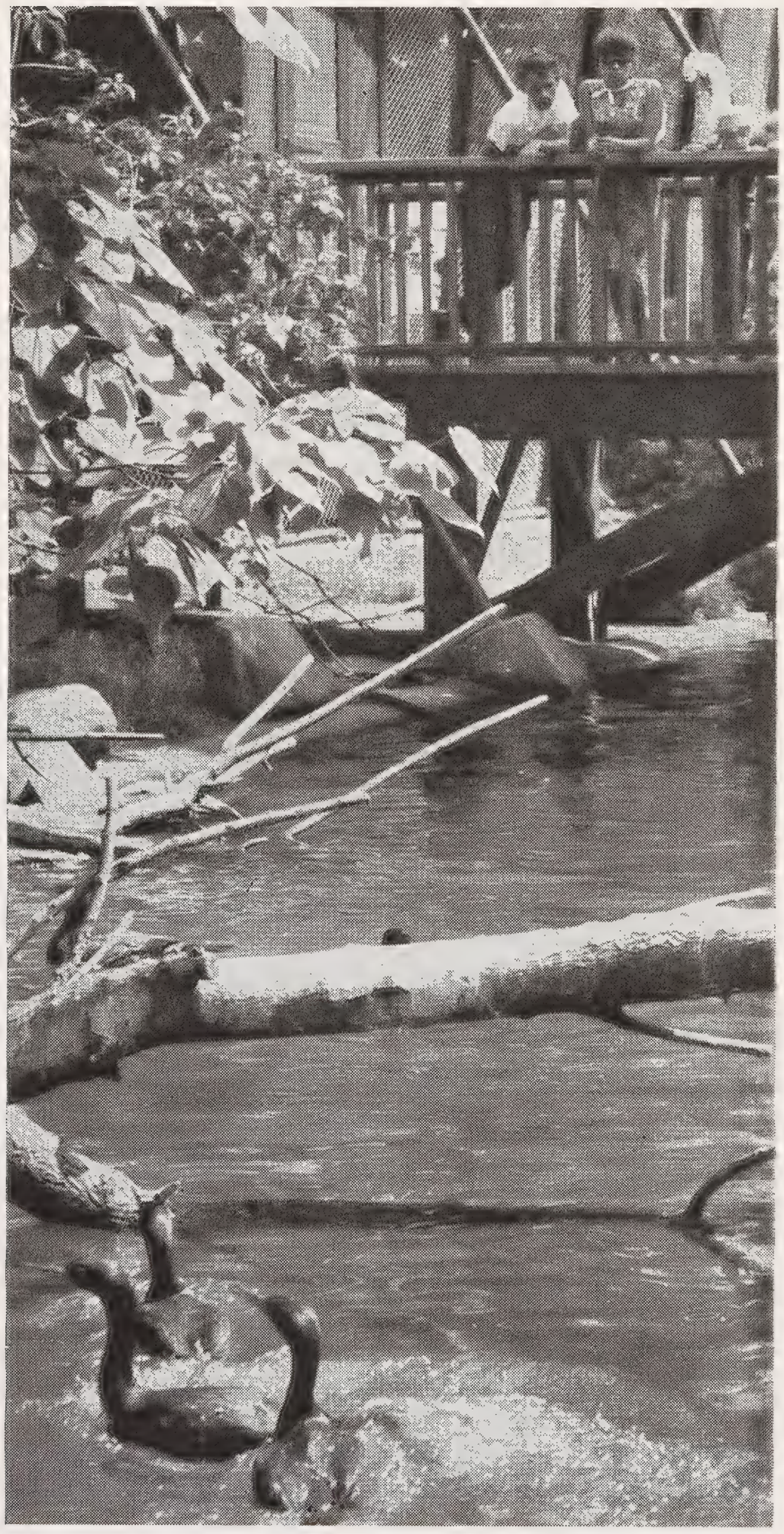
GENERAL
Walter Lerchenfeld, *Comptroller;* Harold C. Palmer, *Assistant Secretary;* John McKew, *Personnel Manager & Assistant to the Director, Zoological Park;* Gordon Cuyler, *Membership Chairman & Administrative Associate;* Jerry M. Johnson, *Curator, Department of Exhibition and Graphic Arts;* John L. Miller, *Editor & Associate Curator, Publications;* Dorothy Reville, *Assistant Editor;* Sam Dunton, *Photographer.*

AFFILIATE
Jackson Hole Biological Research Station
L. Floyd Clarke, *Director.*

A DOOR TO THE OUT-OF-DOORS



By WILLIAM G. CONWAY



Bird Walk, an elevated ramp that runs across the large Flight Cage, is one of the best locations in the Zoo for photography. The beautiful study of two Guanay Cormorants (left) was snapped from the walk.

BIRDWATCHING IS A POPULAR hobby in the United States, but ignorance of birds and their ways is still common among a large section of the population. Nobody understands these two facts better than the curator of birds in a zoo. His life is spent fostering intelligent interest and combatting indifference, and to these ends he employs a uniquely powerful tool: living birds in all their wonderful variety.

The Sunday afternoon zoo-goer may know a lot about birds (if only his local species) or he may enter a bird house merely because its open door is in his path, but it is the profession and pleasure of the man responsible for the collection to broaden the interest of the informed and stimulate the curiosity of the uninformed.

More and more, zoos are doing these two things, for the time is fast disappearing when zoo people are satisfied with caging alone. There is so much to tell about birds, so much to show, so many fascinating chapters in their life story that anyone can read if given a little help.

To the universal appeal of the bird as a living organism we owe the many brilliantly conceived and executed new methods of exhibition in this country and abroad — the habitat

SMITHSONIAN INSTITUTION MAR 28 1967

exhibits, the open, barrierless aviaries, new display concepts where birds are given the chance to live relatively natural lives and to demonstrate their specializations and abilities. Nothing takes the place of direct observations in the field; that goes without saying. But how many of us can give our lives to professional birdwatching?

We can conveniently birdwatch in a zoo, and it can be a rewarding experience. A fine collection of living birds affords those already interested a simulated trip around the earth — conveniently and economically. In the presentation of beautiful creatures of natural worlds increasingly remote to increasing urban populations, a living collection may offer anyone superb recreation and an education. Today the zoo is an urban outpost of wildlife and an advocate of the open door to the excitement of natural history.

Look about at the zoo — you may see a hummingbird from Ecuador, but a breath away a Kookaburra from Australia, almost within reach a stately Sarus Crane from India, a European Robin (so different from our own "robin"), or even an eagle from Africa. You will see, from our own countryside, thrashers, thrushes, warblers, and woodpeckers — all closeup and often within the span of a few unhurried glances.

Birds in zoos are generally well cared for today. Their diets are prepared scientifically, and their breeding requirements usually are understood. Longevity of birds in zoos is proverbial. Birds soon learn that man and other predators are fenced out of their exhibits and that man will not infringe on zoo-bird territory except to offer food.

At the Bronx Zoo, when a storm in 1950 broke a window in the large cage of three Red-billed Blue Magpies from the Himalaya Mountains, the birds were frightened out into the wind and carried several miles away. They managed to find their way back to the cage, entered, and were waiting for their usual feeding the next day.

A Crowned Crane from Africa, whose clipped wings had grown out unobserved, once startled staff and visitors with unscheduled flights over the zoo, always returning to its original enclosure on the "African plains." This spectacular feat was relegated to second place by the majestic, and unexpected, soaring of a trio of Horned Screamers from South America high over a small exhibit at the St. Louis Zoo. These birds, too, returned to their enclosures.

Perhaps because they have learned they are secure, zoo birds, when given the opportunity, behave less secretively than they must in the wild. More and more bird behavior studies therefore are being conducted with captive bird collections. So much curious bird behavior has eluded description in the wild that even the casual zoo-goer may observe and take

The Swamp, one of four open-fronted exhibits in the Zoo's Aquatic Birds Building, is a brilliant example of the modern habitat enclosure. In this realistic setting of cypress and Spanish moss, birds have nested and reared young.

for granted facets of normal bird behavior that no scientist has yet recorded. Of course, many zoo birds interact with the visitor and this reaction, sometimes aggressive, is a compelling factor in the strength of the appeal and inspiration of a collection of birds.

Even the least analytical of zoo visitors watching the curious mutual dance of the black and ivory Jungle Mynas from Bali, the tail pump and flutter of the fabled Quetzal of Central America, or the ridiculously menacing sideways cakewalk of the native Killdeer cannot fail to be entranced by the obvious beauty, even if he is not challenged by the sometimes obscure meaning of bird posturing.

Constant movement and constant change help make exhibits of living birds especially satisfying recreation. They are always new, never dull.

In the zoo, as in the wild, birds are much involved in what they do. Unlike our tail-wagging dogs or gesticulating monkeys, they are less likely to invite comparisons with human qualities, and we are more likely to watch them for themselves.

More leisure time is not only a demand but also a fact of the 1960's — but, what to do with it? Forty-seven artists and amateur photographers were once counted at the six major waterfowl exhibits of the Bronx Zoo on a warm

Saturday in July. The photo shop at the San Diego Zoo sold more than $135,000 worth of film and photographic supplies in 1962. Zoo birds are a major attraction for amateur artists and photographers, and not a few professionals spend hours at their local zoo whenever the opportunity presents.

For the fortunate pet breeder or livestock farmer, there is a special fascination and pleasure in rearing animals. Some of this fascination seems to be attached by city dwellers to the births in their zoos. The announcement of a major zoo birth or hatching is sure to be followed by a swarm of newspaper reporters and photographers and, subsequently, by a deluge of visitors.

Because of the zoo's close rapport with the press and public, it becomes a center for the dissemination of wildlife information and a factor in the relations between bird and man. When an oil tank accident released oil into the Raritan estuary on the eastern seaboard, zoos in Philadelphia and New York were called upon to handle scores of oil-soaked waterfowl and to tender advice to housewives and wildlife agencies in their efforts to save the birds.

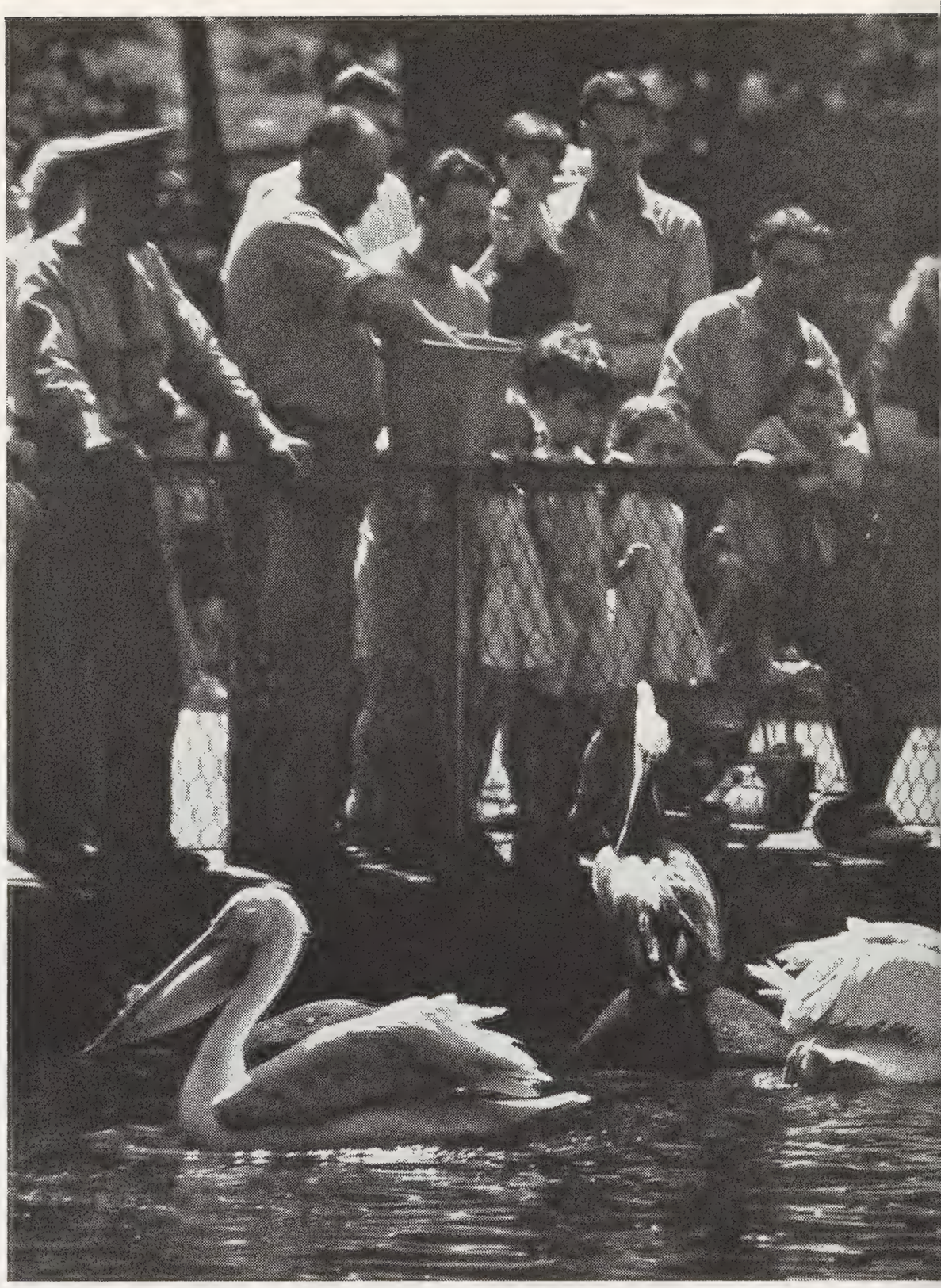
New Yorkers call their zoo almost any time night or day to ask if something can be done for a pair of catbirds whose nest has been blown down in a storm, if a pair of woodpeckers can be kept from drumming on the eaves of their house, if the latest count of Whooping Cranes is up or down, and if peacocks will hybridize with guineafowl. (They will. At least one hybrid is on record.)

There is amazing confusion about what a bird is. Some zoo-goers have trouble accepting penguins as birds on their first visit to the penguin house, and many are surprised to learn that only birds have feathers or that ostriches do not fly. Innumerable parakeet

owners are distressed to learn, from a patient curator, that their pet's eggs will not be fertile unless the bird is provided with a mate. A casual walk through the zoo helps put flesh on sketchy concepts for even the most concrete-bound of urbanites, and the speed with which children grasp the challenging ideas of the assorted sights and sounds presented by a large bird collection and reach for the similarities and dissimilarities in ostrich and hummingbird, eagle and flamingo, is a delight to the naturalist if an embarrassment to the uninitiated parent.

As a longtime zoo-goer-watcher, I have been often amazed at the discernment of youngsters with no natural history education or field experience other than a day at the zoo. Such questions as, "Why do ostriches have feathers if they don't fly?" and the observation of a 6-year-old looking over a dozen species of toucans: "Mother, look, they all had the same father," no longer surprise me. The top honors in my book of sub-adult zoo observations came from a 14-year-old farm boy from Crawford County, Missouri. After reading a sign in front of a cage of birds of prey, he came forth with his own rendering of the Conservationist's classic proposition: "If there used to be lots more huntin' and there used to be lots more chicken hawks and varmits, then chicken hawks and varmits ain't what's hurtin' the huntin'."

Although zoo visitors want to see the largest and smallest, the fastest and slowest, the most bizarre, and the most colorful birds, our familiar native birds usually form the best basis of comparison and appreciation for those who know them. So many people in New York are uninformed about birds beyond the ubiquitous pigeons, Starlings, Herring Gulls, and English Sparrows, that native bird exhibits at the Bronx Zoo have gained great popularity. They offer a challenge to become familiar with creatures that are "ours' — a part of the national heritage.

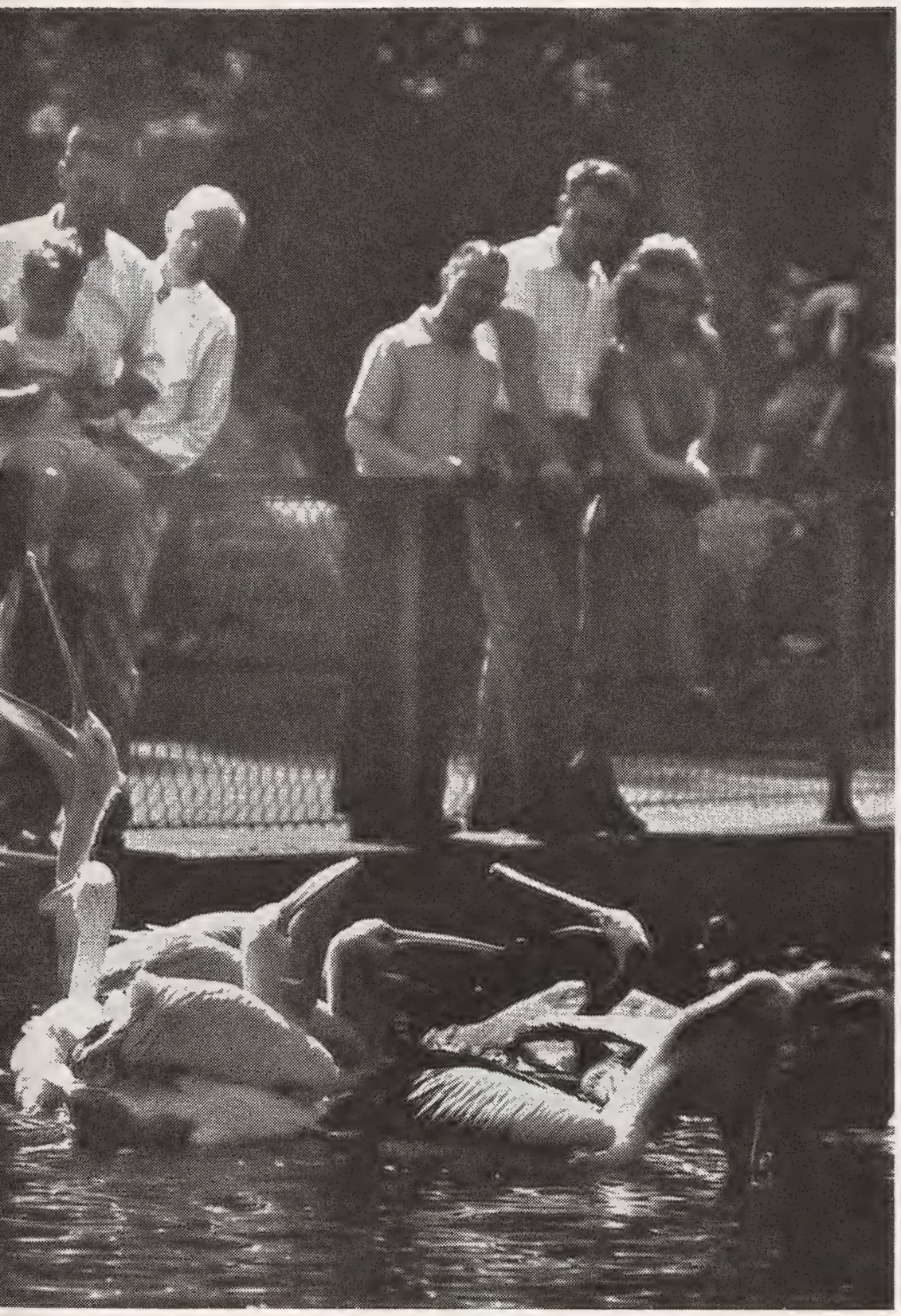


Upper right—The Zoo's pelicans eat fish, supplemented with vitamins and minerals. Below—Flamingos receive a soup-like mixture. Captive birds get beautiful feather coloring from fresh carrot juice.

The informed zoo observer looks for and finds a world of startling parallels and surprising contrasts at the zoo. He is confronted, on one hand, by South American waterfowl which fly south to breed and, on the other, by North American birds which head south to winter. He cannot help but feel a sense of loss when he learns, in his first view of a great South American Condor, that our California Condor is as comparatively rare as the South American bird is common.

The lessons of comparative anatomy and physiology, even of adaptation and nutrition, lie in pleasant ambush at every turn of the zoo's walks. Here a hummingbird that finds it necessary to feed four times an hour during its active day and there a penguin stolidly moulting his entire feathered vestment with no food whatsoever for as long as 4 weeks. An anhinga, a pelican, a cormorant, and a gannet flaunt their adaptations and hide their under-the-feather relationship, while ostrich, emu, and rhea deceptively match adaptation and appearance without such close kinship.

Led on by the simple fish or seed diet of stork or parrot, the zoo observer is confronted with the complicated mix for insectivorous birds and the special soup of the flamingos — a soup compounded not only to preserve life but also to preserve dietary-dependent pink and crimson feather colors. Zoo visitors who have an opportunity to go behind the scenes soon realize it takes an extensive staff and a specialized technology to give proper care to a large, living bird collection.



The Bird Department of the Bronx Zoo, for example, includes a curator, associate curator, headkeeper, assistant headkeeper, six senior keepers, eight keepers, and a secretary. More than 100 food items, from frozen shrimp and live mealworms to protein hydrolysates and vitamin concentrates, are employed in the daily preparation of a score of diets — often individually adjusted as substitutes for the diversified fare to which wild birds have adapted in nature.

Some captive rations are simple; some are complex. Fish-eating birds usually can be fed fresh fish supplemented with vitamins and minerals, but insectivorous species are more demanding. A zoo dietitian can hardly march down to the corner supermarket and buy 50 pounds of assorted live insects (not even fresh-frozen insects) for his several hundred flycatchers, pittas, drongos, ant birds, woodpeckers, helmet-shrikes, and the like. Instead, he compounds a palatable mixture of meat, liver, eggs, and various meals, like a chicken mash supplemented with vitamins and minerals to provide basic quantities of essential proteins, fats, carbohydrates, vitamins, and minerals. The basic ration must then be further modified

for specialized species. Then, by mixing live insects with the "insectivorous mixture," the insect-eating bird is taught to recognize his new ration as food. Sometimes this teaching process is difficult, and highly specialized birds must even be force-fed for a time and persuaded to eat with a variety of technical tricks. Some species, such as the Chimney Swift, which eats only flying insects caught on the wing, are so narrowly adapted that practical methods for feeding them in captivity have not yet been developed.

The deep roseate color of the American Flamingo is dependent upon carotenoids the bird finds in the tiny molluscs, crustaceans, and worms it strains from the mud of lagoon bottoms. For years, zoo specimens deprived of these foods presented a sadly faded appearance. While it had been learned that flamingos would live and breed on a souplike mixture of various cereal meals, meat, and eggs, good practical color supplements had not been found. Eventually, it was learned that a carrot-oil concentrate or even fresh carrot juice contained carotenoids, which the birds could utilize to help color their feathers. Now zoos have red flamingos.

Hummingbirds are also fed on a special soup in captivity but only a few zoos show more than one or two species. San Diego has opened a new hummingbird aviary, where visitors are allowed to mingle with the birds. The Cleveland Zoo a few years ago became the first United States zoo to breed hummingbirds, but the most famous of hummingbird exhibits is undoubtedly the Jewel Room in the Bronx Zoo. There, in a series of small, attractively planted and brightly lighted, glass-fronted displays, hummingbirds have established remarkable longevity records. Several specimens in the air-conditioned, light-controlled exhibits have survived 7 and 8 years. One iridescent-feathered gem, a Caribbean Emerald-throated Hummingbird, lived 10 and

a half years, a remarkable span for a creature of such high metabolism and quicksilver temperament. This bird lived on a blend of sweetened condensed milk, honey, beef extract, cereal baby food, liver protein hydrolysates, and vitamins mixed in water. It also received live fruit flies.

Food is only one part of bird care, however. Daily cleaning of zoo exhibits, preparation of new displays, introduction of new specimens, operation of incubators and brooders, hand rearing of chicks, and constant observation take most of a day in a bird department.

A curator usually begins his daily tasks by reviewing the collection with the headkeeper, walking from exhibit to exhibit. They note the need to move an overly aggressive bird or to consult with the veterinarian concerning health problems of individuals. A decision to obtain a new mate for that crane, to build an artificial nest for this stork, to prepare new labels, to replant an enclosure, to adjust a diet

Left—The Jewel Room of the Main Bird House where several species of hummingbirds have established remarkable longevities. Right—The best of these records, 10 and a half years, was set by a Caribbean Emerald-throated Hummer.

are all typical of an early morning curator-headkeeper dialogue. Keepers report problems and observations at each installation. The curator constantly notes observations on moult, behavior, and development in his notebook for future incorporation in scientific and popular articles.

Eventually, the curator gets to his office where an international correspondence awaits him. Letters from ornithologists requesting information on the captive care of birds they are studying, a letter from a teacher who has found a hummingbird with a broken wing, a list from a collector in Ecuador, a note from a natural history club requesting a lecture, and so on. Meanwhile, his phone buzzes regularly with calls from people who wish information. He dispatches a car to the airport to pick up a Touraco from Africa, gives a tour to a group of college students, consults with the zoo director on budgetary and planning matters and with the zoo's construction department on repair problems. Then he may dash out to observe an exhibit where a manakin is reported building a nest. Each day is hectic, and most days are stimulating for the curator of a large bird collection.

The largest bird collections in America exhibit from 800 to 2,800 birds of 300 to 800 species. Only the biggest, such as those in San Diego, New York, St. Louis, Chicago (Brookfield), Washington, D. C., and Philadelphia, have curatorial staffs.

Bird exhibits at zoos sometimes emphasize the practical aspect of aviculture. The material-minded can hardly ignore a jungle-fowl exhibit, where the ancestors of the domestic chicken are a living testimony to the power of selection. Even the esthete must marvel at the development of a delightfully edible egg-laying machine, capable of depositing 3,000 eggs or more during its lifetime, from a tough little bird which would probably never lay more than 50 eggs during its entire life in the wild.

The wild ancestors of domestic geese and the wild turkey are usually to be seen, and they demand from poultry consumers the sort of respect one might accord some prehistoric "common ancestor" of their various domestic descendants.

Behind each bird exhibited at the zoo lies a story of birds and men, sometimes dramatic but often simple and touching, for the zoo houses repaired waifs as well as daring captures. A window-washer once came to the Bronx Zoo carrying four small sacks. In each was an injured warbler rescued after a collision with one of the Empire State Building's incredibly high window sills. Two were successfully nursed back to health and exhibited in the Zoo's New England Garden for many years. An injured Evening Grosbeak was contributed by a Scarsdale cobbler, a Long Island

A scene from the author's 1960 expedition to the Bolivian Andes to collect James' and Andean Flamingos, later the first of these species ever exhibited alive.

A curator's daily routine inevitably begins with a review of the collection with the head keeper and may also include a lecture to some visiting students.

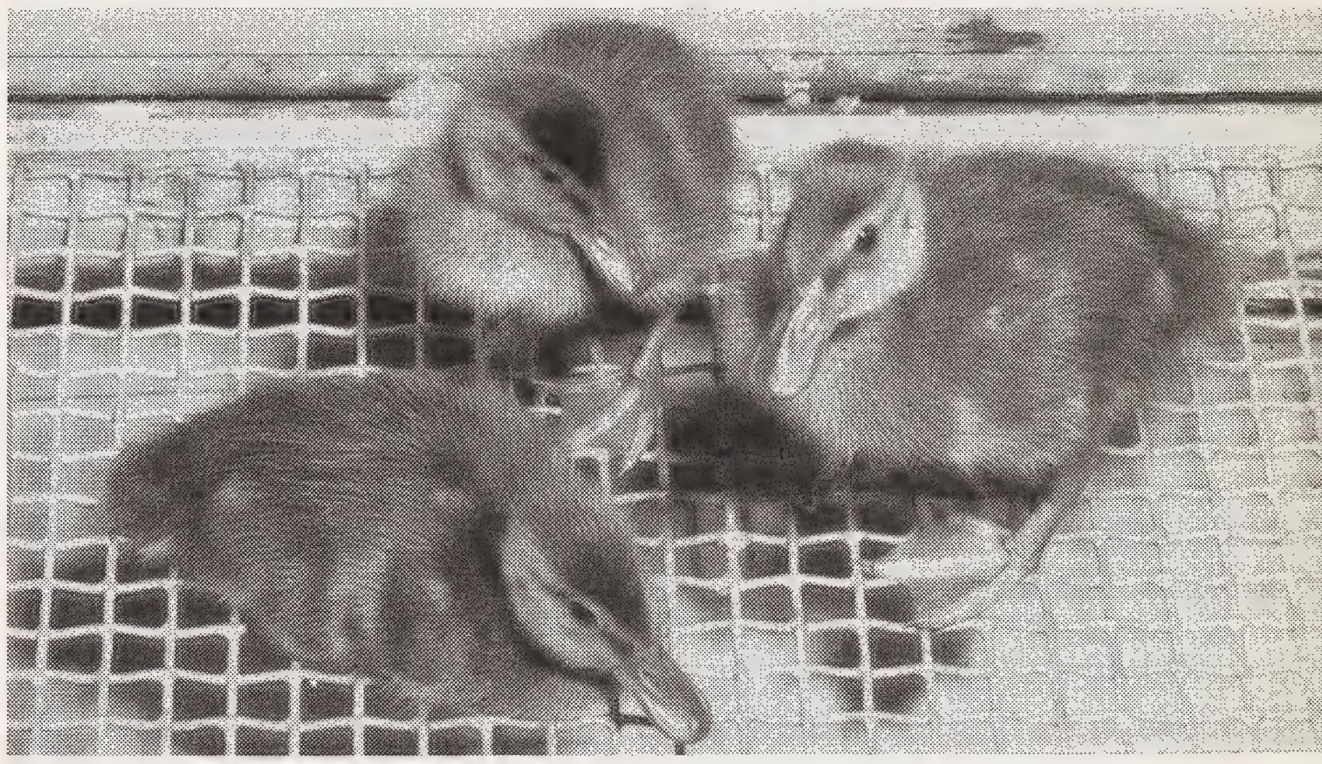
banker drove in with a Saw Whet Owl rescued from a cat, and a Bronx housewife contributed a Killdeer with a broken leg (which later became the great-great-grandfather of a colony of Bronx Zoo-bred Killdeers).

A similar list could be composed by almost any zoo. These contacts often form the basis of a permanent wildlife interest for the bird Samaritan. Almost any zoo can tell at least one story of a hunter, out all day shooting, who finds a wounded bird on the way home, nurses it back to health, and takes pride in presenting it to the zoo.

The arduous expeditions of zoo bird collectors who have traveled to the ends of the earth in order to bring back specimens make up the most intimate of the sagas of bird and

man. A broken leg, filariasis, and 2 long years in the jungle were involved in Charles Cordier's successful capture of the elusive Congo Peafowl in 1949 while he was working for the New York Zoological Society. The only Imperial Pheasants ever captured alive were acquired in Indo-China by Jean Delacour, first among the world's aviculturists, in 1925. Today, in American zoos, as elsewhere, all existing Imperial Pheasants are descended from that original importation. I, myself, brought back the first James' and Andean Flamingos ever captured alive from a 1960 New York Zoological Society expedition to a lake 13,000 feet high in the Bolivian Andes. These strange, high-mountain flamingos were viewed by more people during their first week of exhibition than in all previous history.

Today, zoos are beginning to act to meet a new and melancholy need — as repositories for the scattered population fragments of species



A program of captive breeding in zoos saved the Laysan Teal from extinction when it numbered 25 in the wild. Chicks were hatched in the Bronx Zoo.

which are facing extinction through man's agency. A Sunday at the Cincinnati Zoo in 1914 would have included a visit to see the last Passenger Pigeon. Had aviculture and attitudes been a little further advanced, the Passenger Pigeon might still be with us today, at least in zoos, for it was a species which could easily have been bred in captivity.

While maintaining vanishing species forever in "museum-zoos" is a grim and difficult prospect, it is quite possible that avicultural techniques will be useful in tiding a precarious population over a difficult period, or until new and suitable habitat has been developed or set aside for it. Mammals, such as the American Bison, the European Bison, and the Prjevalski's Wild Horse, are already profiting from such ultimate management. Unfortunately, some birds, among which is the Bald Eagle, are still difficult to breed in captivity.

At the zoo, surrounded by hundreds of species of birds, each different from others of its family and each intent on being its particular kind of bird, we human beings are likely to find a happy recreational escape from the artificial strictures of the man-made to the realities of a world evolved long before our advent and to become aware that wildlife did not evolve for us nor did it depend on us — as it does now. A door to the out-of-doors is opened, and we learn something of our world — and, perhaps, of ourselves.

GROUND SQUIRRELS

"Picket-Pins" o

From Big Bend National Park on the Rio Grande in Texas to Prairie Creek Redwoods State Park in northern California, and from below sea level on the Colorado desert up to over 8,500 feet at Tuolumne Meadows in Yosemite National Park, at camp sites throughout the West, I have found that ground squirrels make interesting neighbors. Almost anywhere west of the Mississippi River one may find ground squirrels of one kind or another. East of that river only two species exist, both ranging into the Great Lakes region.

In open country from Arctic Alaska to tropical Mexico, ground squirrels are common. Burt & Grossenheider[1] list 20 species that inhabit the western United States. All of these they place in the genus *Citellus*, but Walker[2] recognizes four genera of American ground squirrels: *Citellus*, *Ammospermophilus*, *Otospermophilus*, and *Callospermophilus*. I am here using Burt & Grossenheider's common and scientific names. Other ground squirrels occur in Asia, Africa and Europe.

American ground squirrels vary in size from little animals no larger than chipmunks to species as big as tree squirrels. Some have rather long tails that are somewhat bushy; others have very short tails, and some have tails that are pencil-like, fully haired but smooth.

Most ground squirrels are colored rather dully in shades of gray, buff, and brown, and with indistinct markings. A few have bright colors, and some have distinct stripes or other markings. The showiest of them all is the Golden-mantled Squirrel (*Citellus lateralis*) with its copper-orange head and a white stripe bordered with black on each side. Because of the stripes, this little squirrel is widely but mistakenly called a "chipmunk."

Like the other ground squirrels, the Golden-mantled makes its nest in a burrow, but it is

Our Wild West

By FRANK F. GANDER

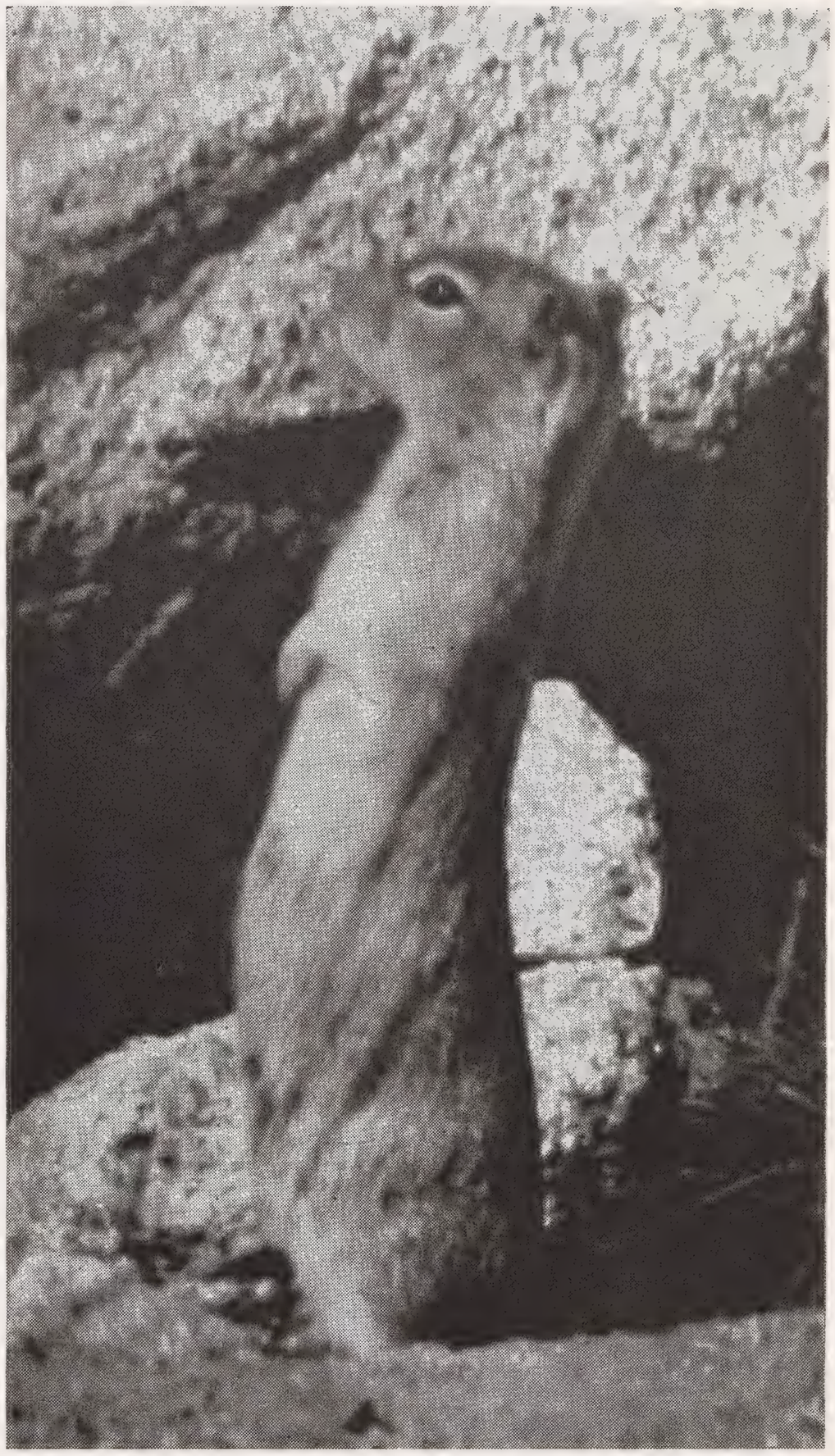
the one species that regularly lives among trees. All other ground squirrels are found mostly in open country — meadows, prairies, deserts and sparsely brushed or wooded areas. It is probably because they are animals of open country that they are not found in the eastern states, all of which were originally forested.

The Thirteen-lined Ground Squirrel (*Citellus tridecemilineatus*) does extend as far east as Lake Erie and central Ohio, but it is a very wide-ranging species and is found throughout the prairie states from coastal Texas up into Canada. This was the only ground squirrel I knew as a boy in Wichita, Kansas. It was common in farm lands and golf courses in that area, and even in some vacant lots on the outskirts of the city.

This is an attractive little squirrel with its back decorated by 13 stripes, light ones alternating with dark ones. Within each dark stripe is a series of light-colored spots that are sometimes confluent and form a light stripe within the dark stripe. It has very small ears, as do many ground squirrels. Throughout much of its range this animal is called "gopher," and in some regions it is known as "picket-pin."

This last name is applied to several different ground squirrels inhabiting western range lands. When watching for danger, they sit stiffly erect and look much like wooden stakes in the grass. The story is widely told of the tenderfoot who attempted to picket his horse to one of these live "picket-pins." The Spotted Ground Squirrel (*Citellus spilosoma*), Richardson Ground Squirrel (*Citellus richardsoni*), and Belding Ground Squirrel (*Citellus beldingi*) are some of the species to which this name is applied.

One August I camped among Belding Ground Squirrels at Tuolumne Meadows in



A California Ground Squirrel (left) in its familiar alert pose. Like the Belding's Ground Squirrel (above), it often sits back stiffly on its haunches, from whence comes the colorful name "picket-pin."

Yosemite National Park. These are small buffy gray squirrels, each with a broad brown band down its back and with the underside of the tail a bright fulvous. As soon as the morning frost had melted, these squirrels were abundant in the meadows. Their clear, whistled alarm notes were sometimes heard, and they

were often seen in the stiffly erect "picket-pin" pose.

Whenever one of these squirrels found a filter that had been discarded by some smoker, it carried it into its burrow, apparently for use as nesting material. While the squirrel probably did not realize it, the nicotine in such filters probably reduces the chances of the nest becoming infested with fleas and other insect parasites.

At that high altitude, the very chilly mornings and evenings restricted the time of activity of these squirrels even on summer days, and, in addition, at least six months of each year were spent in hibernation. It was not surprising, therefore, that during their active hours they were always eating. Some of them accepted cookies and crackers from the hands of campers, but grass and similar herbage formed most of their diet. When one of their number was run over on a road, others were soon observed feeding on the carcass.

This is a common trait of ground squirrels and it is especially noticeable with the big California Ground Squirrel (*Citellus beecheyi*). It is a common sight in the spring to see one of these squirrels that has been run over on a highway and others, usually of its own kind, feeding upon it. This is not the only meat eaten by California Ground Squirrels, for they are definitely carnivorous.

These squirrels raid poultry yards and take eggs or young chickens. They eat birds' eggs and young, and they are a very serious threat to the California Quail. Insects, lizards and mice are also eaten by California Ground Squirrels. Once they dug out and ate two nests of baby cottontails in my garden.

From an economic viewpoint, however, the carnivorous habits of these squirrels are overshadowed by their fondness for grain, fruits and other commercial crops. They climb trees readily and carry away and store large quantities of avocados, apricots, plums, peaches, pecans, almonds and other fruits and nuts. They even steal acorns from the hoards of the Acorn Woodpecker, and carry these to their underground caches.

California Ground Squirrels are very fond of the leaves, blossoms, bulbs and roots of many plants. I have watched them come up on my porch, cut off begonias and similar plants growing in flower pots, and carry away the entire plant. In a single day they may take all the blossoms from a bed of poppies, godetias, or other flowering plants. Nothing edible is safe from them!

In completely wild areas, California Ground Squirrels are seldom so abundant as to become a threat to the vegetation of the area. But when people move in and destroy the rattlesnakes, kill or drive away the large hawks, owls, eagles, badgers, foxes, coyotes, and bobcats, natural controls of the population are gone and the ground squirrels thrive and multiply and costly artificial controls are necessary.

While sometimes they become a trial to their human neighbors, California Ground Squirrels are attractive and interesting animals. About the size of the Eastern Gray Squirrel, they have fairly long tails that are just slightly bushy. Their color is mostly brown flecked with lighter flecks, and they have gray patches on their shoulders.

Many years ago I kept two of these squirrels as caged pets and found them to be gentle and easily handled[3]. More recently, in Kissing Rocks Garden near Escondido, California, I tamed a free-living individual so that it would come and take food from my hand. These squirrels form an interesting part of our California biota, and, at present, they seem to be in no danger of extermination.

California Ground Squirrels range north to the Columbia river where they are commonly called "gray diggers," and they range southward into Baja California, Mexico. In the mountains, their range overlaps that of the Golden-mantled Squirrel and the Belding Ground Squirrel. In the San Joaquin Valley and along the edge of the desert they may be found in the same area with antelope squirrels.

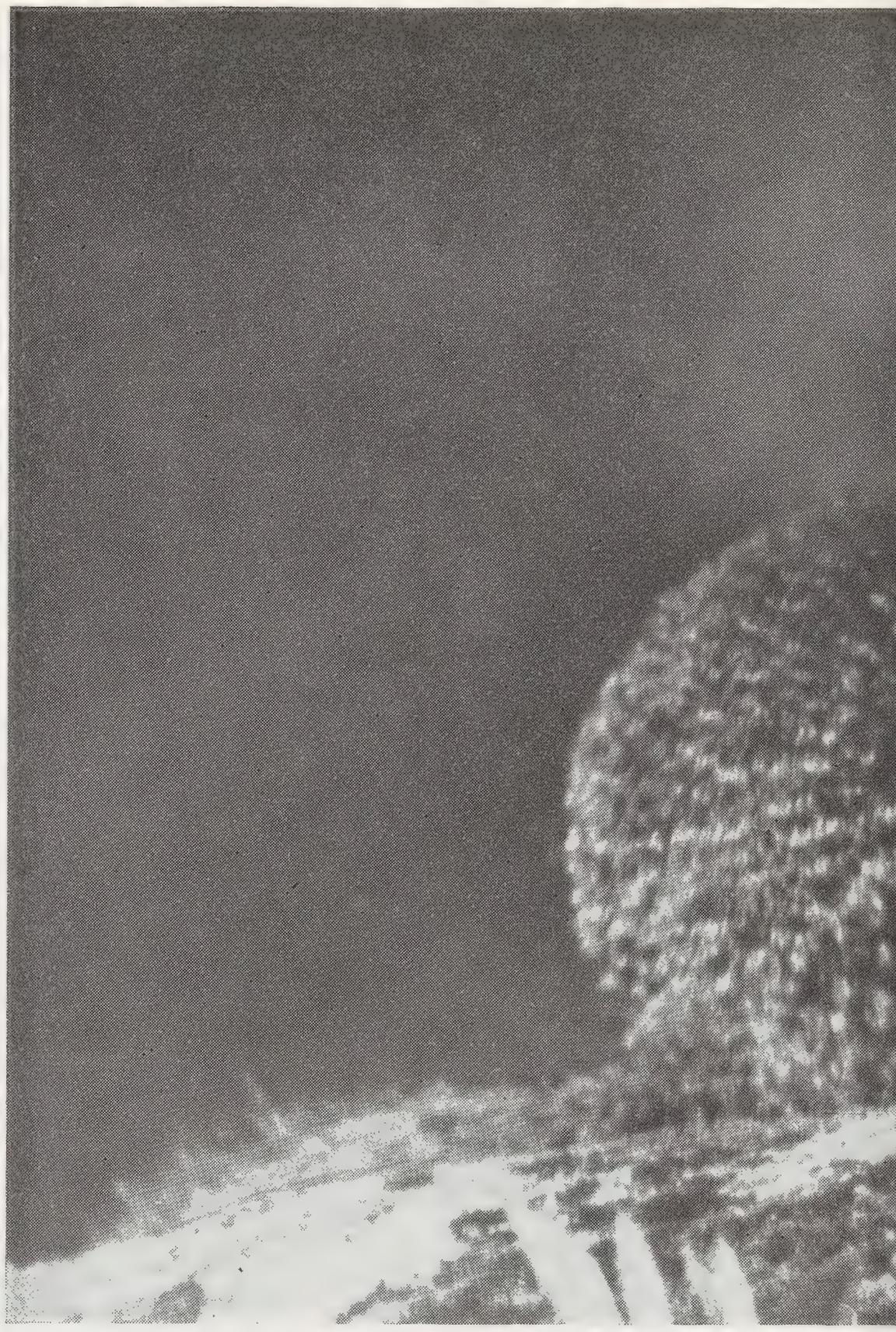
In many places in the West, two or three species of ground squirrels occur in the same area, but each species occupies its own par-

The Golden-mantled Ground Squirrel is the showiest of all with its copper-orange head and white stripe bordered with black on each side. It is the one species that regularly lives among trees. All others live in open country.

ticular niche. At high elevations in Yosemite National Park, Golden-mantled Squirrels live in the forests and Belding's live in adjacent meadows. The two species may often be seen together where their habitats join.

Similar to the California Ground Squirrel is the Rock Squirrel (*Citellus variegatus*) which ranges through Arizona, New Mexico and western Texas. It occurs north into Nevada, Utah, and Colorado, and far south into Mexico. Another similar species, the Franklin Ground Squirrel (*Citellus franklini*), ranges from Kansas to the southern tip of Lake Michigan and northwestward into Canada. The Arctic Ground Squirrel (*Citellus parryi*), with smaller ears and shorter tail, is found over most of Alaska and northern Canada.

Some ground squirrels have very restricted ranges. One of these is the San Joaquin Antelope Squirrel (*Citellus nelsoni*) which is found only in the San Joaquin Valley of California. It is a small, buffy-gray squirrel with a white stripe along each side, and, like other antelope squirrels, when running it carries its tail forward over its back. The Whitetailed Antelope Squirrel (*Citellus leucurus*) and the Yuma Antelope Squirrel (*Citellus harrisi*) are closely similar in appearance. All are widely called "desert chipmunks."



Ground squirrels vary greatly in both size and marking. The lovely Antelope Ground Squirrels (left) are only about half the size of the California Ground Squirrel (above). The Thirteen-lined Ground Squirrel (right) has a wide range extending across the Mississippi to Ohio.

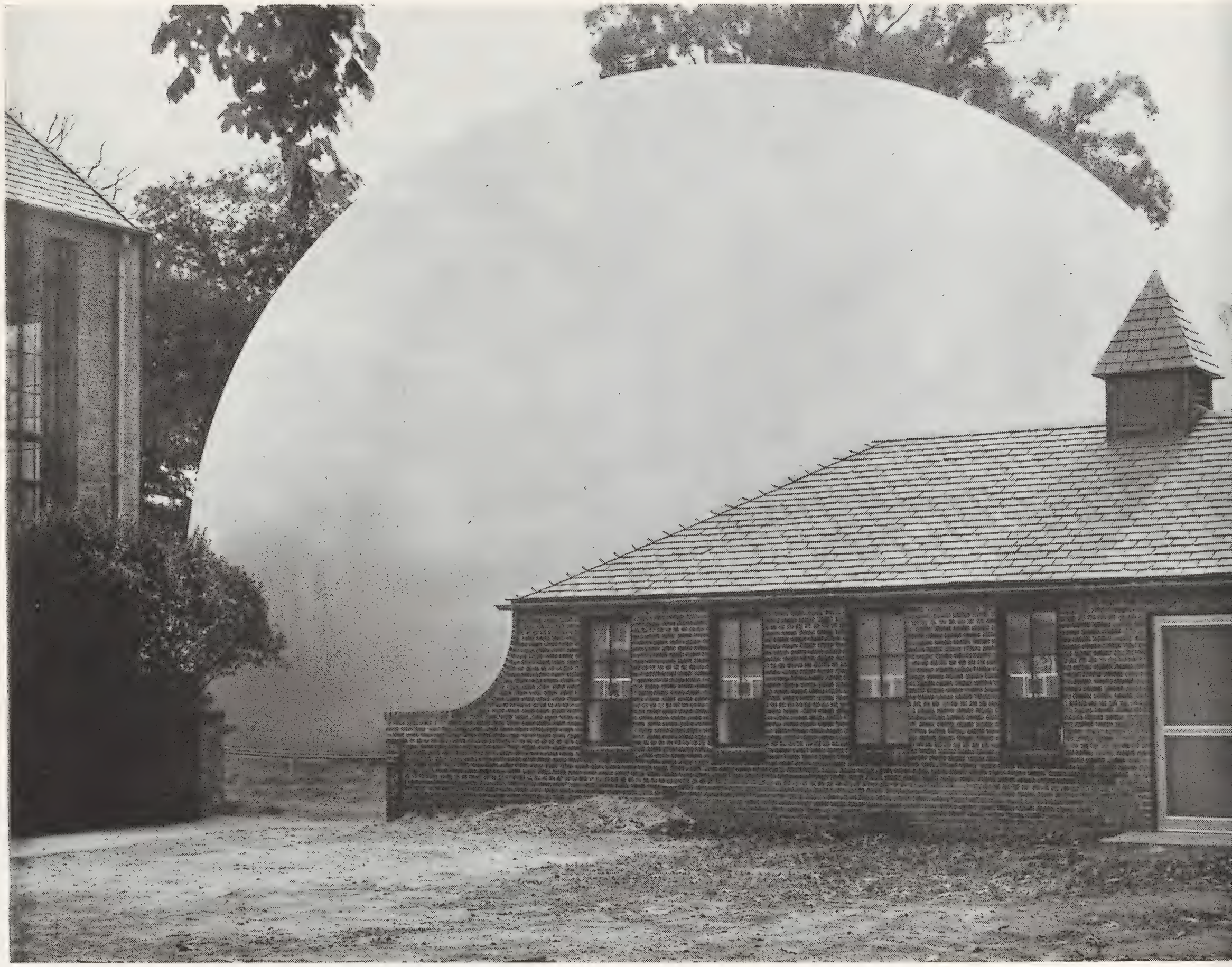
At Organ Pipe Cactus National Mounument, I found the Yuma Antelope Squirrels so tame that they would come and take food from my hand. At Joshua Tree National Monument, the Whitetailed Antelope Squirrels were equally tame. One of these had just taken a tidbit from me and was running back toward its den when it ran right across a large Gopher Snake (*Pituophis*) that had been crawling at right angles to the squirrel's route.

The snake grabbed for the squirrel but missed. The little mammal dropped its food and gave a cry of alarm. After a few feet, it stopped, turned back with all of its hair standing erect, and, while keeping at a safe distance, with eyes and ears it warily inspected the snake. There was no sign of the terror that all small rodents traditionally are supposed to show when near a dangerous snake. The snake did not attempt to pursue the squirrel but continued on its way to a spring, where it paused to drink.

Such narrow escapes are common occurrences in the lives of ground squirrels, but while almost all predators in the western states feed upon ground squirrels, automobiles probably kill more than any of their natural controls.

Even in highway-laced areas ground squirrels seem to be holding their own, for, as might be expected, they are very prolific. There are usually from five to eight young in each litter, and this seems to be enough to maintain a high ground squirrel population under most conditions. Eventually the rapidly expanding human population will probably crowd out some species of restricted range, but other wide-ranging species that are more adaptable will undoubtedly continue to exist long after the predators that feed upon them have disappeared. And so long as our national monuments and national parks remain inviolate, they will continue to add interest and enjoyment to our camping trips in the West.

1. Burt, William Henry, & Richard Philip Grossenheider, *A Field Guide to the Mammals,* pp. 62-70 Houghton Mifflin Co., Boston, 1952.
2. Walker, Ernest P., *Mammals of the World,* pp. 709-712. The Johns Hopkins Press, Baltimore, 1964.
3. Gander, Frank F., "Development of Captive Squirrels," *Journal of Mammalogy* 11(3):315-317, Aug., 1930.



NEWS FROM IRAB-
Institute for Research in Animal Behavior

By ROBERT A. BROWN

A LONG-AWAITED CALM finally developed in the early evening on Friday of the last week in September, and as the wind subsided there came a sudden and dramatic change to the Bronx Zoo's familiar skyline.

All that week engineers and scientists, workmen and interested parties had waited in an atmosphere of impatience; when the favorable time came, fan-driven blowers were turned on and in the course of 30 minutes a large nylon hemisphere rose from the ground, pushing up to a height of 43 feet and out to a diameter of 70 feet.

We were a bit worried about the innocent motorist on his way home along the Bronx River Parkway; would this sudden "outer space"

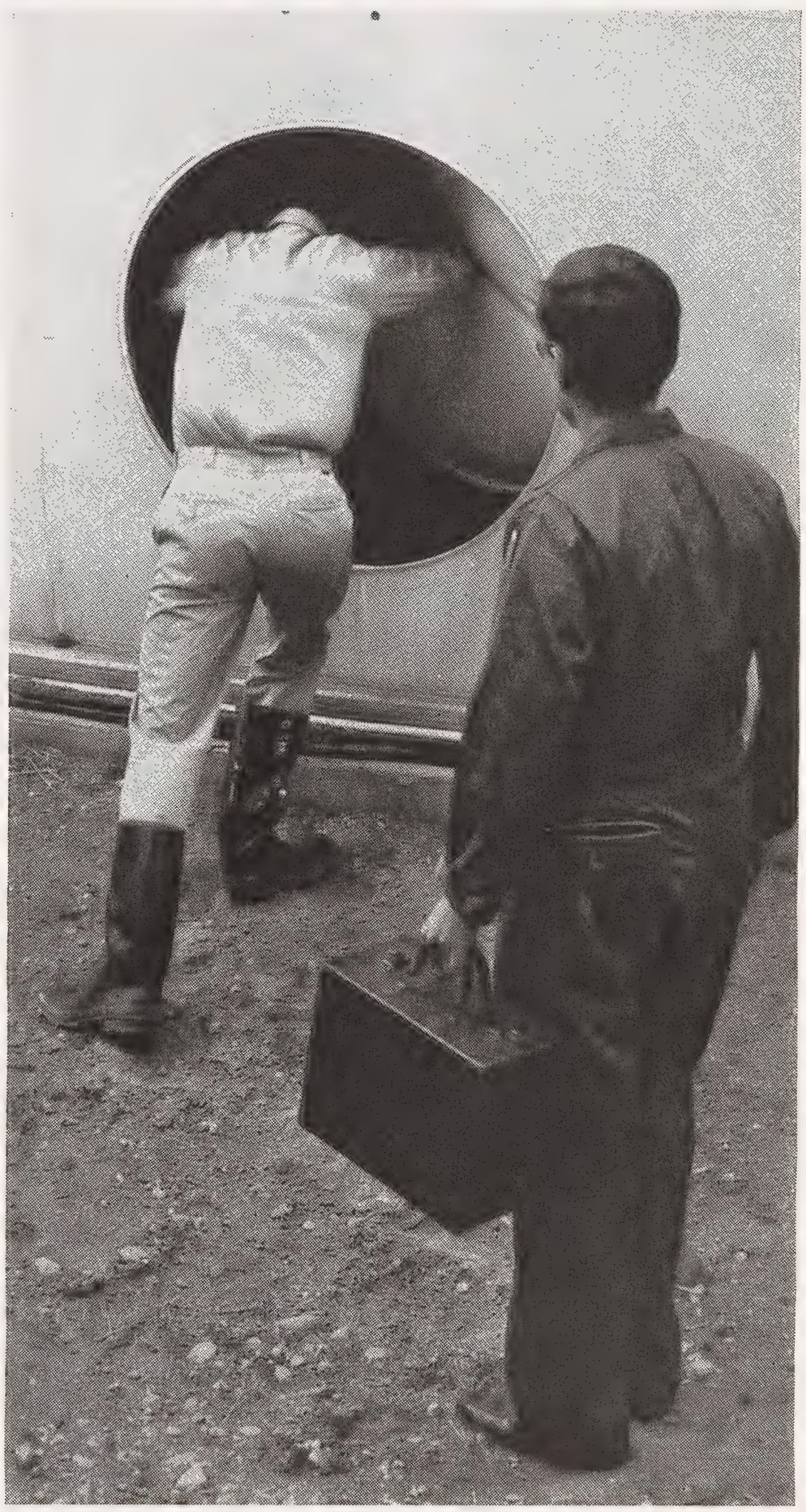
scene amid the trees and brick quarters inside the Zoological Park frighten him? (As far as we can determine, there were no auto mishaps along the adjacent stretch of parkway.)

Air domes enclose space economically and are now often used over tennis courts in the winter. *Our* dome, however, has a unique function; its inner surface, a uniform blue color, will serve as the artificial sky in a test chamber for studying the ability of Adelie Penguins to tell direction. Field studies by Dr. Richard L. Penney have shown that Adelies possess this ability so long as clear skies prevail and the sun is visible.

An artificial sun, using an automobile headlight, is now under construction, and it will move across the dome above the horizon in the same apparent path that the sun takes during the Antarctic summer. When completed, the dome interior will be similar in some respects to a planetarium.

While the dome is the most conspicuous recent change at the old Farm-in-the-Zoo area of the Zoological Park, it is by no means the only one. Renovated buildings of the Animal Behavior Laboratory now house sound-proof cages for the study of the development of bird song, a large dark room for the study of echolocation in flying bats, an experimental wind tunnel for the study of bird and bat flight, and a specially designed room to house Adelie Penguins under conditions similar to those in Antarctica. These facilities form a laboratory for scientists from the Institute for Research in Animal Behavior. IRAB, as it is called in the Zoological Park, is sponsored jointly by the Society and Rockefeller University (formerly Rockefeller Institute). Other IRAB facilities are located at Rockefeller University in Manhattan and at the Society's William Beebe Tropical Research Station in Trinidad. In addition, IRAB is now supporting scientific field work in Africa by George Schaller on lions and by Thomas T. Struhsaker on primates.

It is hoped that the Institute will play an important role in the field of ethology, the study of the natural behavior of animals. Indeed, it appears to occupy a unique position combining the scientific talents of a leading University in the field of biology and the animal collections and know-how of the Zoological Society. Specific projects of the Institute will be reported on in future issues of *Animal Kingdom.*

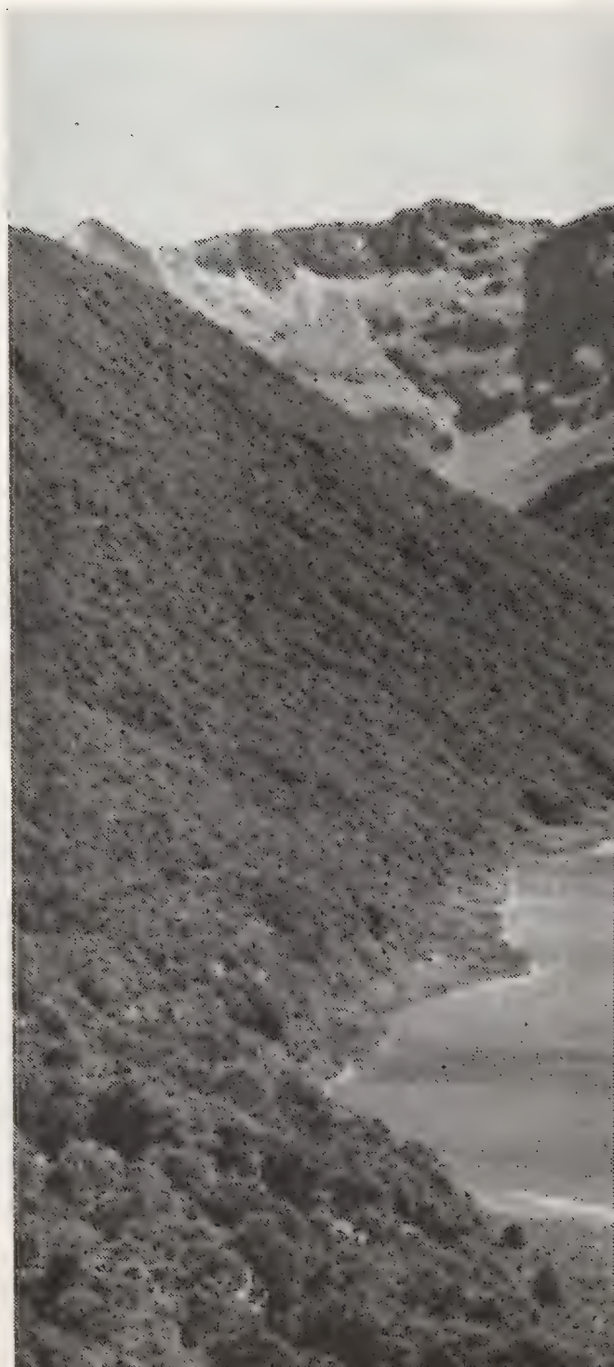


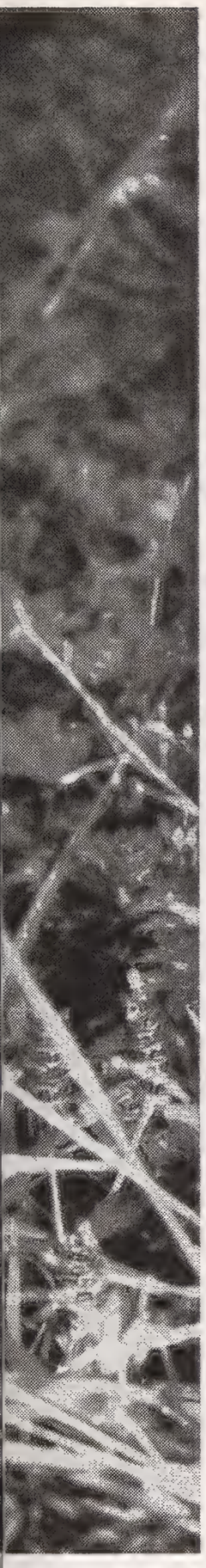
This 70-foot-diameter nylon dome will soon house an artificial sun-simulator for use in the study of sun-orientation by Adelie Penguins. It was raised to its height of 43 feet in 30 minutes time by a pair of fan-driven blowers.

The dome, which has added a new dimension to the Zoo's skyline, is entered through an extremely windy round door. Dr. Penney brought back 14 pairs of Adelie Penguins from Antarctica for use in his work.

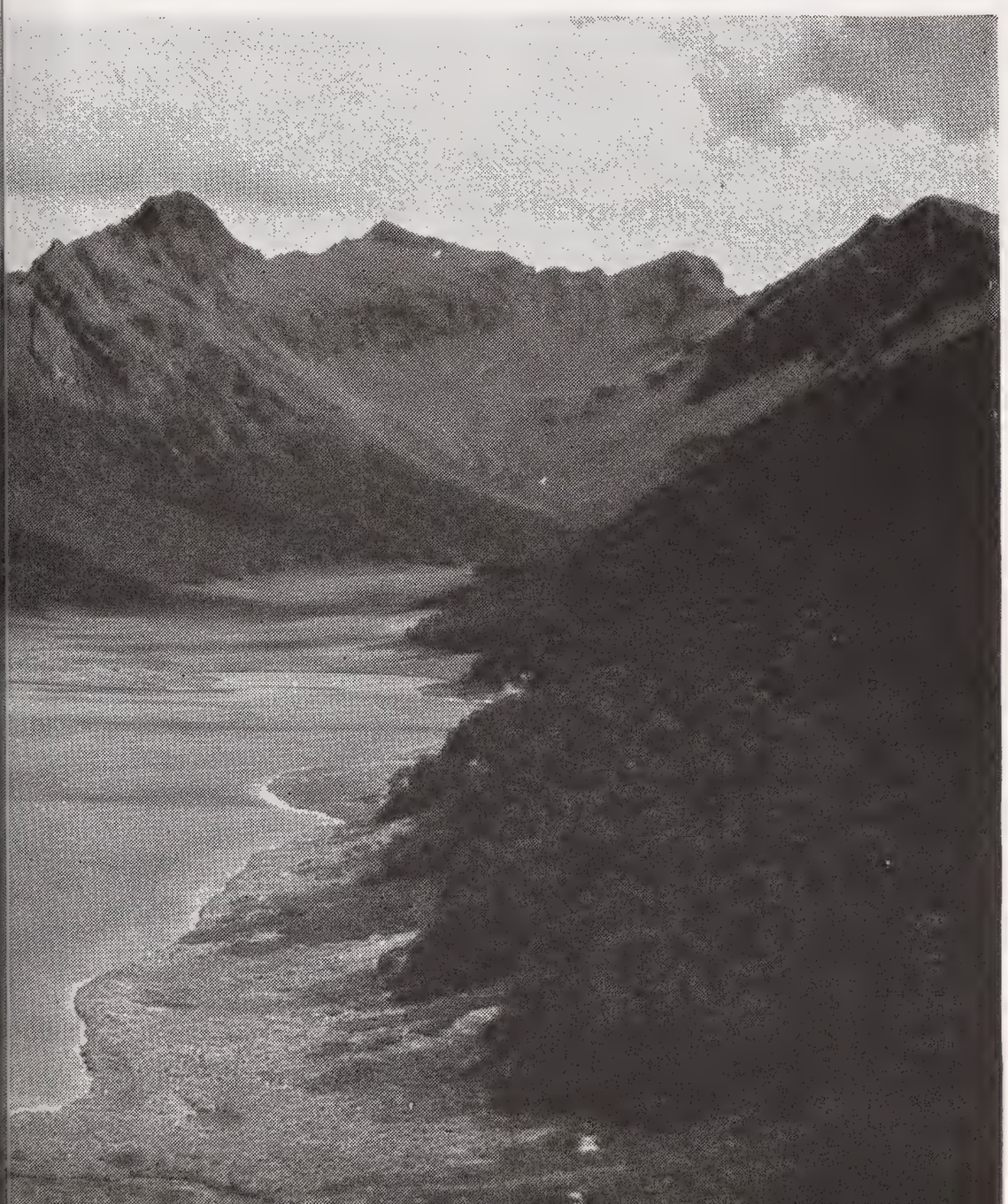
A New Zealand Oddity:

THE FLIGHTLESS TAKAHE





Left — The Takahe was considered extinct until it was "rediscovered" in the wild Fiordland region of New Zealand's South Island in 1948. Below — Dr. G. B. Orbell found living Takahes in a valley that was unmarked on existing maps. The valley has been named for these birds and the lake for their discoverer.



By DAL STIVENS

NOW WE HAVE IT – now we do not. That is the story of the flightless Takahe of New Zealand, a member of the rail family. Like the Coelacanth, it was first discovered as a fossil and thought to be extinct; then it was found to be in existence, though in small numbers. Later it was once more thought to be extinct until, astonishingly, it was rediscovered in 1948.

This curious chronology began in 1847 when the naturalist Walter Mantell found some ancient bones of the Takahe near the mouth of the Waingongoro River in southern Taranaki, on South Island. The bones were sent to Sir Richard Owen who called the "extinct" species *Notornis mantelli* or Mantell's southern bird.

Then, just two years later, a live Takahe, an iridescent-blue and turquoise-green bird about the size of a big rooster, was caught and eaten by sealers in Dusky Sound. The skeleton ended up in the British Museum, as did that of a second caught and eaten two years later (1851) in Thompson Sound. Nearly two decades passed before another Takahe was sighted (and killed) by a man hunting rabbits near the present town of Te Anau in 1879. This specimen was sent to the Dresden Museum. That was it for another 19 years, when a dog killed a Takahe on the shores of Lake Te Anau. The New Zealand Government promptly bought this "last" bird for the Otago Museum.

There then followed a period of 50 years during which the flightless Takahe was again considered extinct. From time to time there were rumors that an odd bird had been sighted, but investigations of these reports led nowhere. The observers had either been mistaken or had confused the Takahe with its close but much smaller relative, the Pukeko (*Porphyrio porphyrio melanotus*), the New Zealand native swamp hen which is not flightless.

The living Takahes might have remained unknown to science — or even become extinct for reasons which we shall discuss later — but for the persistence of an amateur ornithologist, Dr. G. B. Orbell, of Invercargill, who tracked

These captive Takahes, above eating a rat and below drinking water, were part of a small colony brought to the Mt. Bruce Native Bird Reserve on New Zealand's South Island. The breeding project failed.

down all reported sightings and made frequent searches in the wild Fiordland region of the South Island. Here, a thick Antarctic beech forest covers an area containing many lakes and great ice-topped mountains as high as 10,000 feet.

Much of this wild and spectacular region is still unexplored and, indeed, the little lake around which Dr. Orbell found living Takahes in 1948 was not then even marked on maps. It has since been appropriately named Lake Orbell.

A natural accident may have protected the handful of birds that Dr. Orbell discovered in what is possibly their only stronghold. The stream which drains the remote valley, now called Takahe Valley, runs underground, and the valley has no obvious entrance. It is quite possible that until Dr. Orbell entered Takahe Valley, no human being had been there before. Dr. Orbell found the Takahes living at about 3,500 feet in the Murchison Mountains on the western side of Lake Te Anau. It is at just about this height that the Antarctic beech gives way to scrub and snow tussock grass.

Dr. Orbell's discovery made headlines. Within a month the New Zealand Government declared an area of 435,000 acres "closed" in order to protect the 500-odd acres where the birds were found.

Two years later, a search of Takahe Valley found about 20 breeding birds and between 40 and 60 non-breeding birds. Later expeditions have discovered other small colonies.

The habitat of the Takahe is between 3,300 and 3,800 feet, although they occasionally come down to the 3,000-foot level to the tussock-thick floor of Takahe Valley. In 1958, four birds and some eggs were taken in an attempt to breed Takahes at a state wildlife sanctuary. Unfortunately, these efforts failed and the last of these captive birds died early in 1965.

Takahes have gleaming, iridescent-blue breasts and turquoise-green backs and wings; their heavy beaks and strong legs are a brilliant scarlet. Males are larger than females. Although their wings are large, they are poorly muscled.

The Pukeko is another New Zealand bird and closely related to the Takahe. But unlike the Takahe, the Pukeko, or Swamp Hen, is an omnivorous bird in no immediate danger of extinction, and it can fly.

Dr. Orbell's rediscovery of the Takahe points up the fact that New Zealand is a living museum of archaic forms of plant and animal life, including several other species of flightless birds, the well-known Kiwi, the Kakapo (night parrots) and the Weka (another rail). It is believed that New Zealand became separated from other land masses about 70 million years ago and has no native land mammals other than two species of bats. One natural consequence of the absence of predatory mammals is the evolution of flightless birds. This has happened on a number of islands, most notably on Mauritius, home of the now extinct Dodo, and on Madagascar, where *Aepyornis* once existed. New Zealand's birds lived for millions of years in dense, sub-tropical forests and isolated mountain valleys where food was plentiful and predators, other than a few hawks, were probably rare. Gradually several species of ground-foraging birds lost their power of flight. The most famous of these were the 20 species of now-extinct moas, ranging from the giant *Dinornis maximus*, which stood about 12 feet high, to smaller ones about two and a half feet tall. *Dinornis maximus* was extinct when the Polynesians (Maoris) reached New Zealand in their long canoes from the central Pacific about 600 years ago. Some of the smaller species, however, were still in existence. Predation by the Maoris undoubtedly hastened their end, but it is probable that changes in the environment also contributed.

Dinornis maximus was about the same size as *Aepyornis* of Madagascar, perhaps the source of the stories about the giant roc of *The Arabian Nights*. It is now thought that the Bush Moa may have persisted until early in the 19th Century. Strength was lent this belief by the discovery of some well-preserved Bush Moa remains in a cave in Takahe Valley.

When the Maoris first came to New Zealand, the North Island subspecies of the Takahe, which is now extinct, had a range over much of the southern portion of the island. The existing South Island subspecies was dis-

The huge limestone overhang is typical of the Murchison Mountains 5,000 feet above the floor of the Takahe Valley. Long ago, Maori moa hunters found shelter in the many limestone caves in the area.

One of these Maori caves contained Takahe and Bush Moa bones, Kakapo feathers and a hunter's flax sandal. Kakapos are also known as Night Parrots. The Bush Moa was one of the 20 now-extinct moa species.

tributed from western Nelson to Southland. The Maoris hunted the large flightless birds on both islands for food and for their plumage. And Europeans who settled in New Zealand beginning in 1840 introduced stoats and weasels, which surely preyed on the birds and several species of the deer, which probably caused a change of the natural environment.

Takahes also appear to be handicapped by a low reproduction rate and by specialized food habits. Their main food is the tender base of a few varieties of snow grass; when the grass is blanketed with snow the Takahes move into the forest and eat fern stalks and other plants. Contrasted with this restricted food range is that of the closely related Pukeko (about one-third the size of the Takahe), an omnivorous bird in no immediate danger of extinction. As well as eating leaves, roots of water plants, grasses, clover, berries and seeds, Pukekos will also eat worms, fish, birds' eggs and young birds. Still, some ornithologists maintain that the two species are so alike that the Takahe is merely an aberrant Pukeko and should be called *Porphyrio mantelli* instead of *Notornis mantelli.* In addition to marked anatomical similarities, the two have one feather louse in common — another indication of a possible shared ancestry.

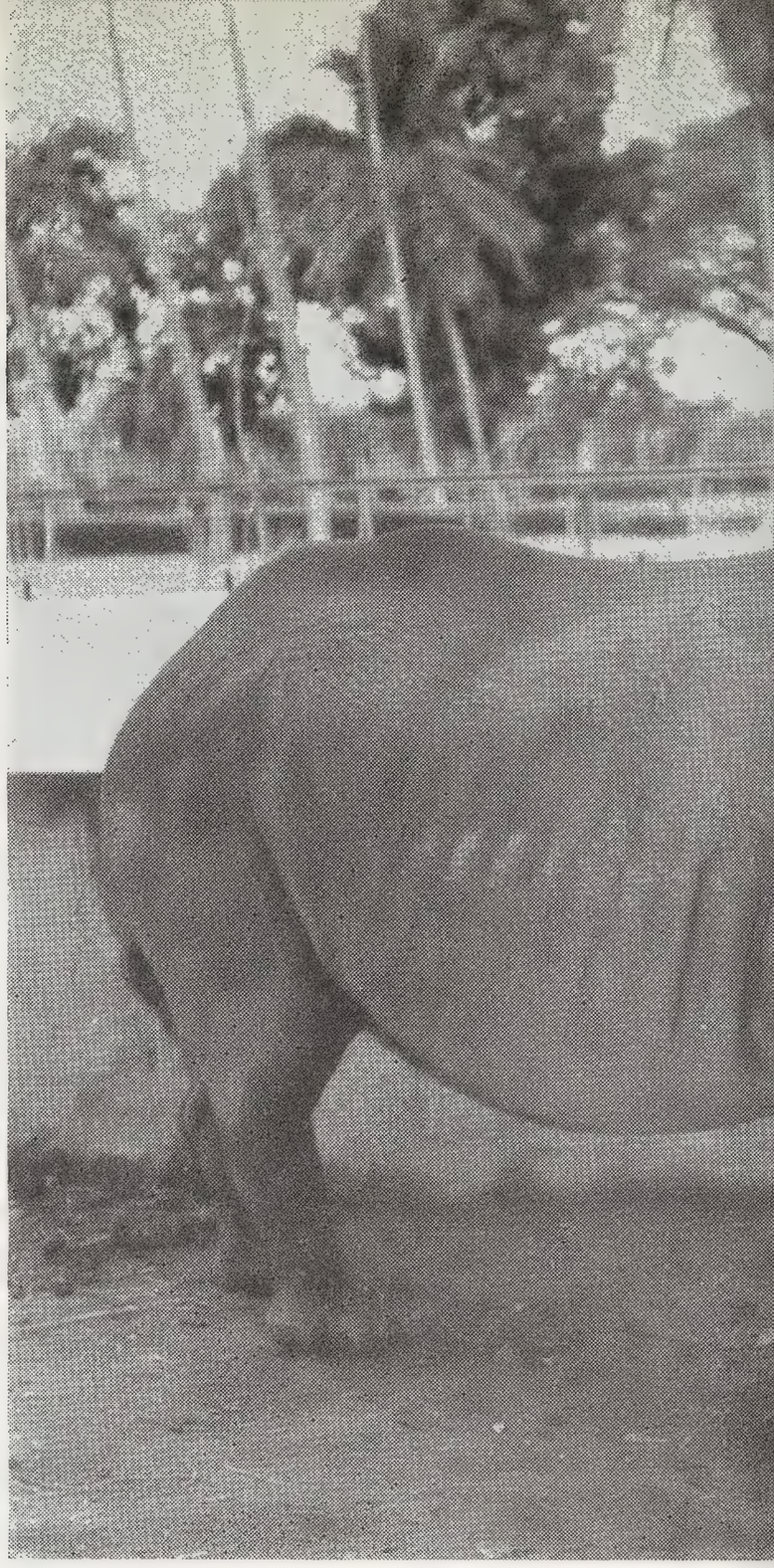
Takahes of both sexes have similar plumage and both are strong runners. Although their feet are not webbed, they swim well for short distances. When walking, both Takahes and Pukekos flick their tails continuously. This flicking speeds up when the birds are nervous. The Takahe's alarm note is a deep, resonant thumping sound. When calling to the female, the male utters a high-pitched "klowp!" Her call is a lower-pitched honking sound.

These unique flightless birds could well become extinct in spite of strenuous efforts to preserve them, for their numbers are very low and the genetic pool is small. Moreover, introduced stoats and weasels are dangerous and unfortunate introductions which threaten not only Takahes, but other unique New Zealand birds. Deer, particularly red deer, because there are no natural checks by predators, have overrun much of the back forest country. The deer are destroying the undergrowth of the

forest and the tussock grasses, and this is causing serious erosion. Government cullers kill 30,000 deer each year without appreciably affecting their numbers.

Takahe ecology revolves around snow tussock grasses. Not only do they live on them, but they make their nests of and under snow tussocks. The large, well-hidden circular nest is about 16 inches across. The female lays a clutch of one or two pale buff eggs, spotted with brown and mauve. Incubation, which is shared by the pair, takes four weeks. It is rare for more than one egg to hatch. The chicks when newly hatched have black, almost furry, down. They are fed on insects by both parents. Maturity is reached at three to four years. The limited amount of suitable food, the severe climatic conditions of the Fiordland, the birds' low rate of reproduction and comparative slowness in reaching maturity, have all undoubtedly contributed to the low numbers. Only energetic conservation — and some luck — can save them from *lasting* extinction.

Takahes mold their tunnel-like nests out of snow grass. Incubation is shared by both male and female and lasts four weeks. It is rare for more than one egg to hatch. Below—Chick in its black furry down.



An Indian Zoo Breeds an African Rhinoceros

By JOHN L. MILLER

Mr. C. D. Krishne Gowda, Curator of the Chamarajendra Zoological Gardens in the Indian city of Mysore, recently sent us a series of photographs highlighting the successful captive breeding of a pair of African Black Rhinoceroses.

Although there have now been more than 20 captive births and rearings of this species, such an event is never taken lightly by zoologists and conservationists. It is, without doubt, a noteworthy achievement whenever and wherever it happens—in Frankfort, in Cincinnati, or in Mysore.

The most numerous species of rhinoceros, *Diceros bicornis* is gone from much of its former range and is now concentrated primarily in Kenya and Tanzania. The true color of the Black Rhino is dark yellowish-brown to dark brown, or slightly darker than the greatly endangered African White Rhino, *Cerathotherium simum*, which isn't really white at all.

The Mysore calf was born last August 26, a little over 10 and a half years after the arrival of the parents, and the birth is all the more significant because of the determined efforts of Curator Gowda and others on his staff.

These efforts were concentrated into attempting to get the male rhino interested in the female when she came into heat, every 30 to 35 days. Mr. Gowda reports that the male failed to respond until it was given doses of a special hormone called Testoviron in powdered form mixed with its regular diet. The first successful breeding took place more than two years later.

The gestation lasted 458 days. The birth

was completed about 20 minutes after the front legs first appeared. Licked immediately by the mother, the calf was about the size of a half-grown pig. Its body was without hair, except on the lining of the ears and the end of the tail. There were two white patches on the horn-growing regions of the head.

According to Mr. Gowda, the birth was completed at 2:15 p.m. Fifteen minutes later it was struggling to get to its feet, which was accomplished in another 30 minutes, at 3 o'clock. By 3:30 the calf was moving toward its mother in search of her teats, and it first began suckling at 4:35.

* * *

Varying in degree, all species of rhinoceros, two African and three Asian, are either rare or close to extinction in the wild. Largest of the five is the African White or Square-lipped Rhinoceros. Estimates of its surviving

(Continued on page 31)

Clockwise—Upper left—Mysore Zoo's pair of Black Rhinoceroses peering over the wall of their enclosure. The female is on the right. Center—The female late in her pregnancy shortly before she gave birth. Upper right—The baby struggling to stand on the day of his birth. Center right—Double nourishment, mother at her wicker "plate" and calf at her teats. Bottom—Beginning course in ways of self-defense.

IN THIS ISSUE

The Cover

The photograph of one of the Zoo's peacocks in display was taken by Society member **Paul G. Kovac** with a Nikon F. He also took the photo of the Guanay Cormorants that appears on Page 3. The April issue of *Animal Kingdom* will feature a series of Bronx Zoo pictures by Mr. Kovac.

Zoo Birds

Author **Conway** claims he started visiting zoos at the advanced age of three years, began cleaning cages (through the magnanimity of a St. Louis Zoo reptile keeper) at age 11, held his first zoo job as a summer keeper at 17, and has been unable (and unwilling, we expect) to get away from zoos in the 20 years since.

In addition to being president of the American Association of Zoological Parks and Aquariums (AAZPA), he is on the advisory committee of the International Zoo Yearbook, a member of the Survival Service Commission and a recently-elected member of the board of directors of the National Audubon Society.

Mr. Conway's article appeared originally in the book "Birds in Our Lives," published in a limited edition earlier this year by the Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, U. S. Department of Agriculture. The book, which includes 60 other contributors, was written "to give readers an opportunity to achieve a greater appreciation and a deeper insight into the impact of birds on our civilization." It may be ordered for $9.00 by writing the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

Ground Squirrels

Frank Gander is the Resident Naturalist at the Silverwood Wildlife Sanctuary in Lakeside, California. He has written for *Animal Kingdom* previously on the Scrub Jay (April, 1966) and on raccoons (June, 1966).

IRAB

Robert Brown left his job with a Wall Street firm to join the staff of the Institute for Research in Animal Behavior. He is Research Manager of the Animal Behavior Laboratory at the Zoo and a sort of "general manager" over the pet snakes, frogs and turtles kept at home by his three sons.

Flightless Takahe

Dal Stivens is a free-lance writer living in Australia who specializes in articles on the many animal oddities that inhabit his native country, New Zealand, and the nearby islands. The Takahe piece and earlier articles for *Animal Kingdom* on albatrosses (June, 1966) and the Tuatara (October, 1966) resulted from a visit to New Zealand early last year.

Baby Rhinoceros

The first recorded birth of a captive-bred rhinoceros was the offspring of a male Sumatran Rhinoceros and a female Hairy-eared. The event took place on January 30, 1889, at the Zoological Gardens of Calcutta. This was followed by a gap of 36 years before a second captive birth of an Indian Rhino, also at the Calcutta Zoo, but the calf was born prematurely and lived only a few hours. The third captive-bred animal, an African Black Rhinoceros, was born at the Brookfield Zoo in Chicago on October 7, 1941.

In the area of longevity, Indian Rhinoceroses lived for over 40 years at the Antwerp and London Zoos and for a reported 47 years at the Calcutta Zoo. A female of this species received at the Bronx Zoo on May 24, 1923, died on January 25, 1962, a period in captivity of 38 years, 8 months and 1 day.

BEHIND THE SCENES

Zoo "Landmark"

The Paul J. Rainey Memorial Gate, which serves as the Bronx Zoo's entrance-exit to Fordham Road, was recently given the official designation as a New York City "landmark" by the Landmarks Preservation Commission.

The gate was the gift of Mrs. Grace Rainey Rogers in memory of her brother, a sportsman and patron of the New York Zoological Society. It was designed by the distinguished American sculptor Paul Manship and erected in 1933. The beautiful bronze animal figures which sit atop the gate are also Manship's work, and they include a number of Zoo celebrities of the early 30s — "Buster," the huge Galapagos Tortoise, "Jimmy," the Shoebill Stork, and "Sultan," the magnificent African Lion.

Prior to his death in 1923, Mr. Rainey made an expedition to the Arctic, returning with two Polar Bears, a Walrus and six Muskoxen for the Zoo.

New Mammal Chairman

Assistant Curator Brad House has been appointed chairman of the Bronx Zoo's Mammal Department following the resignation of Curator Joseph Davis. Mr. House joined the staff early in 1965. He formerly had been an assistant director of the Jackson Hole Wildlife Research Station in Wyoming.

Oklahoma City Leopard

Following the loss of the male of a breeding pair of Snow Leopards at the Oklahoma City Zoo, the Bronx Zoo agreed to receive their female in the hope of breeding her to our male.

The baby Spotted Leopard with Nurse Vinnie Martine was born in January to the Zoo's black female and spotted male. Observed in a weakened condition the next day, it was removed to be hand-reared and is doing nicely.

Since arriving early in February, she has settled down somewhat, but Mammal Curator House says that her introduction to the male will be delayed until she demonstrates observably friendly tendencies toward him in an adjoining exhibit at the Lion House.

Aquarium's Olaf Dies

Olaf, the magnificent 3,000-pound Atlantic Walrus who was the first inmate of the New York Aquarium when it opened its doors at Coney Island on June 5, 1957, was found dead last December 14 in the large pool that was his exhibit-home.

Spectacular in size and abounding in friendliness and charm, Olaf was a great favorite with the public and with the curators and keepers at the Aquarium from the time he arrived from Greenland as a youngster weighing a mere 250 pounds. Last June 15 he was the featured attraction at the garden party for members of the Zoological Society when his prowess for eating clams was pitted against three of Coney Island's best clam shuckers.

Olaf, the New York Aquarium's mighty 3,000-pound Atlantic Walrus, who died unexpectedly in December. The photograph was made last June at the Zoological Society's garden party. He weighed 250 pounds when he arrived as a youngster in 1957.

Dr. Ross F. Nigrelli, Director of the Aquarium, said that Olaf appeared to be in good health on the day before he was found dead. He had taken his usual diet, consisting of 150 pounds of clams and fish. Dr. Nigrelli said that the cause of death was suffocation resulting from the aspiration of regurgitated food, a complication from the twisting of the intestine.

Since May 10, 1962, when the big walrus complex was dedicated, Olaf had lived with three Gray Seals in a large pool, 70 feet long, 40 feet wide and eight feet deep. This pool and a smaller one adjacent to it hold 135,000 gallons of salt water. Olaf's death ended plans to mate him with Sapiunuk, a four-year-old female.

Although walruses live much longer in the wild, Olaf's 10-year, two-month longevity at the Aquarium is the second best record in captivity. A female walrus once lived 11 years and 10 months at the Copenhagen Zoo. But Olaf did attain the greatest weight of any captive specimen on record.

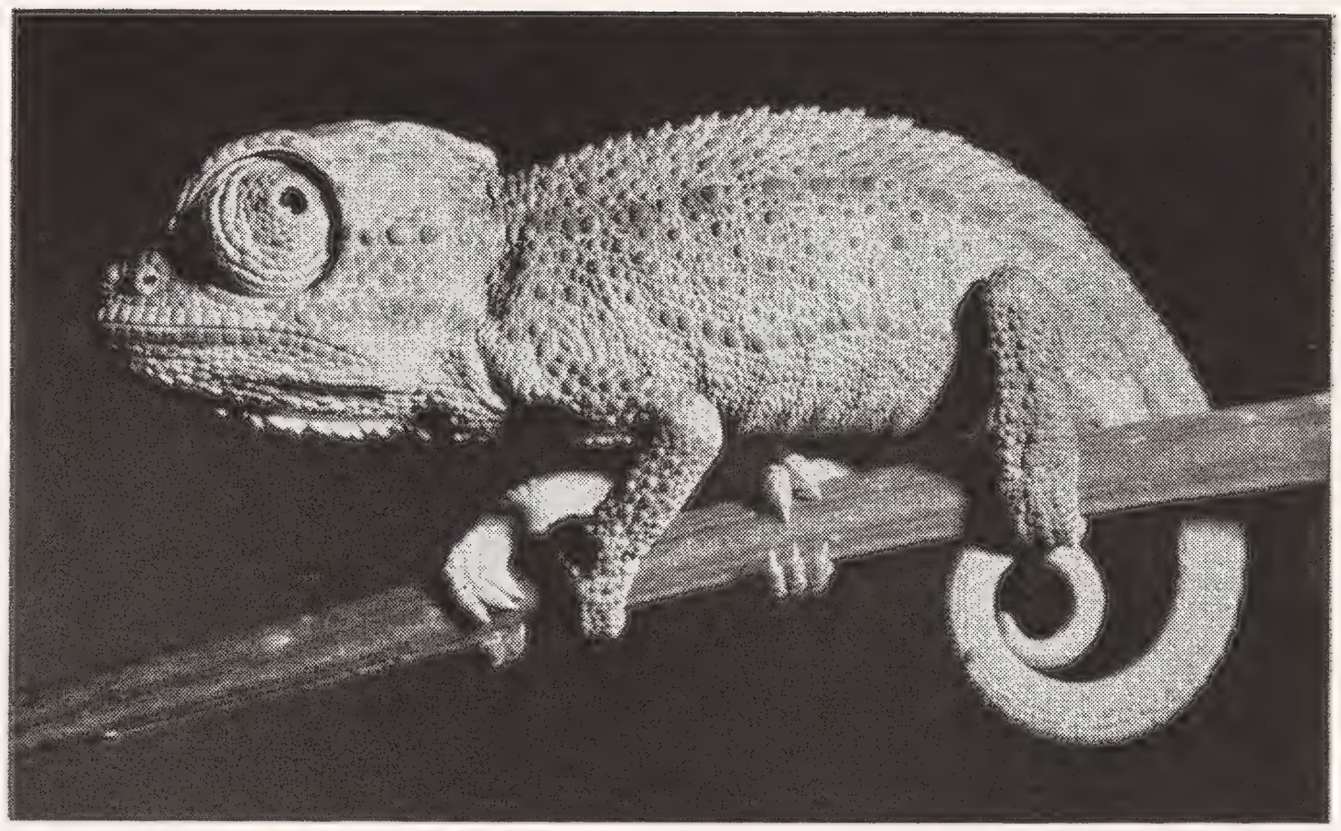
Less than three weeks before he died, Olaf's tape-recorded voice was issued in a recording that was part of a published scientific paper analyzing his underwater calls. The recording was bound into the autumn issue of *Zoologica,* the scientific quarterly of the Zoological Society.

Flamingo Photo Wins Prize

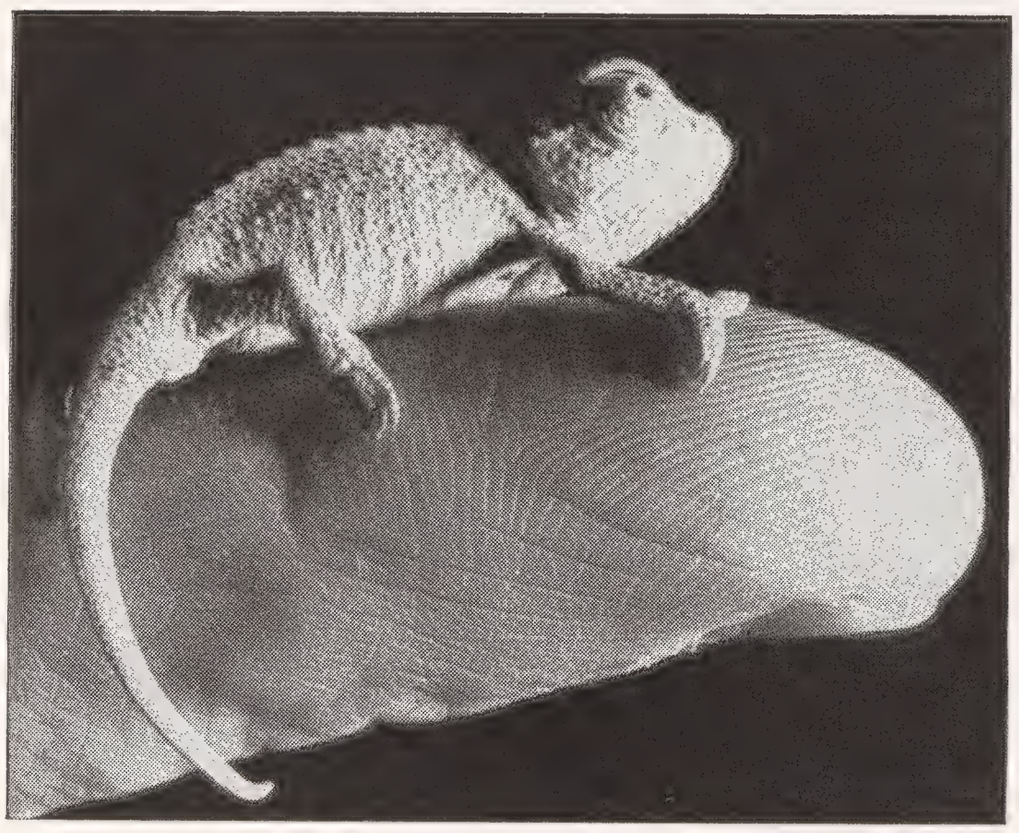
In the recent competition of the New York Press Photographers Association, photographs by Neal Boenzi of the New York Times took first prize in four of the 11 special categories. One of the four was in the animal category, and it was Mr. Boenzi's photo of the first flamingo hatched at the Zoo that won. The picture was taken on the day of the hatching, last June 28.

Zoo Poster Available

An attractive three-color poster of the Bronx Zoo can be purchased on premises in a mail-



This baby African chameleon was one of 16 unexpectedly born to a female adult purchased by a man at a local pet shop. He turned the babies over to the Reptile Department, which is attempting to rear them on a diet of fruit flies and other tiny insects.



ing tube or can be ordered by mail from the Zoo's Publications Department. The poster, which was designed by B. J. Johnson of the Zoo's Department of Exhibition, costs one dollar.

An African Rhinoceros

(Continued from page 27)

number vary, but Walker gives the figure of 600 for the Zululand reserve of South Africa. It has also been reintroduced into Kruger National Park and is found in small numbers in the southern Sudan, Uganda and adjacent parts of the Congo.

Smaller and considerably more aggressive is the African Black Rhino, once quite common in East Africa from Ethiopia south to the Cape and westward to Cameroon and Angola.

Since its first breeding in captivity in 1941 at the Chicago Zoological Park, it has been bred at the Pittsburgh, Cincinnati and Detroit Zoos, all in the 1960s. The first Black Rhino calf bred and reared in a European zoo occurred in Frankfurt in 1956.

The Indian or One-horned Rhinoceros (*Rhinoceros unicornis*) is the largest of the Asian species. It was once widely distributed from Kashmir southeastward into Indochina. Today, those that remain — perhaps a total of 500 — are living in several government reserves in India and in the Kingdom of Nepal.

A smaller one-horned species, the Javan Rhinoceros (*R. sondaicus*) is down to an estimated 30 to 40 specimens in the Udjung Kulon reservation of western Java. It once was found from Burma, Thailand and Indochina south to Sumatra and Java.

Smallest of all living rhinoceroses is the Two-horned (*Didermocerus sumatrensis*), which is broken into two subspecies, the Sumatran Rhinoceros (*D. s. sumatrensis*) and the Hairy-eared (*D. s. lasiotis*). The Sumatran is found in Sumatra and Borneo, while the Hairy-eared with its ear fringes is found in Burma, Thailand and the Malay States.

ILLUSTRATION CREDITS

Cover — Paul G. Kovac; p. 2 — Paul G. Kovac; pp. 3, 5, 6, 7, 8, 9, 10 (bottom) — N.Y.Z.S. photos; pp. 10-11 (top) — National Geographic Society photo; p. 11 (right) — N.Y.Z.S. photo; p. 12 — Robert Reville; p. 13 — Frank F. Gander; pp. 15, 16 (bottom) — N.Y.Z.S. photos; pp. 16-17 (top) — Frank F. Gander; pp. 17 (right), 18, 19 — N.Y.Z.S. photos; p. 20 — National Publicity Studios, Wellington, New Zealand; pp. 20-21 (bottom), 22, 23, 24 — Dal Stivens; p. 25 (top) — National Publicity Studios, Wellington, New Zealand; p. 25 (bottom) — Dal Stivens; pp. 26, 27 — Chamarajendra Zoological Gardens.

Publications of Interest

SMALL MAMMALS ARE WHERE YOU FIND THEM. By Helen Damrosch Tee-Van. 148 pp., many maps, diagnostic sketches and illus. by the author. Alfred A. Knopf, New York, 1966. $3.50.

It is a relief to find an author-illustrator who is not afraid to begin a book intended for general sale with a Classification of Mammals and who feels it important to start each section with a listing of Order, Family, Species and such general data as Length, Height, Weight and Habitat, as required by the subject. It is all the more remarkable when it appears that the book is intended for young people — remarkable, that is, because this sensible and natural procedure is not more commonly followed. Obviously author and publisher have faith that *some* sub-teenagers have orderly and inquisitive minds! The straightforward text will give them the essential natural history of many smaller members of six Orders: Marsupialia, Insectivora, Chiroptera, Edentata, Lagomorpha, Rodentia and Carnivora, and maps and diagnostic drawings admirably supplement the text. A birthday present of this book might be a good way to start a young naturalist on an absorbing career.

William Bridges

THE WORLD OF THE WOODCHUCK. By W. J. Schoonmaker. 146 pp., profusely illustrated. J. B. Lippincott Company, Philadelphia and New York, 1967. $4.95.

THE WORLD OF THE PORCUPINE. By David F. Costello. 143 pp., profusely illustrated. J. B. Lippincott Company, Philadelphia and New York, 1966. $4.95.

Two more volumes of the "Living World Series" have come to our attention and they uphold the quality of excellent and abundant photographic illustration and factual and readily absorbable natural history for young naturalists. Though the series is designed for younger readers the material is inclusive and sound and benefits anyone interested in our fellow creatures.

My only reservation is that in *The World of the Woodchuck* the author implies that his natural history covers all three species of marmots in North America when, in fact, it adequately covers only the Woodchuck, *Marmota monax*. The point should be made that the Yellow-bellied Marmot, the Hoary Marmot and the Woodchuck differ not only in appearance and distribution but in significant behavioral and ecological characteristics.

Hugh B. House

A Guide to Field Identification: BIRDS OF NORTH AMERICA. By Chandler S. Robbins, Bertel Bruun, and Herbert S. Zim. Color illustrations by Arthur Singer. 340 pp., Golden Press, New York, 1966. Paperbound, $2.95; clothbound, $4.95.

This new publication has several useful innovations. It not only covers a much wider area than most popular bird guides — from the Mexican border through all of the United States and Canada — but the text on each bird is directly opposite the page containing its full-color illustration. Individual maps, located in the margins, outline the fall and spring migration routes and the nesting and wintering areas. Photographs of audiospectrograms, or Sonograms, also share the margin space and are supposed to make the identification of bird songs relatively easy. Only time will tell how useful these Sonograms will be to the average birding enthusiast.

Superb illustrations, painted by Arthur Singer, help to make this a most attractive, pocket-sized field guide.

Dorothy Reville

ANIMALS OF THE NORTH. By William O. Pruitt, Jr. Drawings by William D. Berry. 173 pp. Harper & Row, New York, 1967. $5.95.

Don't be mislead by the appearance of such terms as "ecosystem" and "taiga" early in the text of this admirable book. It is, essentially and in the simplest narrative style, an account of how animals and plants get along together in the harsh northland. If we understand that interweaving, we can understand much more. Dr. Pruitt makes certain we *do* understand a great deal about the lives of voles, hares, lynxes, caribou, moose and other elements in a complex world.

William Bridges

THE WORLD OF THE POLAR BEAR. By Richard Perry. 195 pp., map and 12 illustr. University of Washington Press, 1966. $4.95.

Mostly a scissors-and-paste job, based on voluminous reading, with too much emphasis on old and dubious scources, but nevertheless dealing with an animal that is very much in conservationists' thoughts these days. It is a pity that it is not more first-hand and authoritative. Indicative of the slap-dash compilation is the badly proofread list of scientific names in the back and the minor but revealing point that Lee S. Crandall's "The Management of Wild Mammals in Captivity" is listed in the Bibliography as "The Management of Wild *Animals* in Captivity."

William Bridges

BIRD STUDIES AT OLD CAPE MAY: An Ornithology of Coastal New Jersey. By Witmer Stone. 941 pp., profusely illustrated with black-and-white line drawings and photographs. Dover Publications, Inc., New York, 1966. Two volumes, paperbound, $2.95 each.

The coastline of New Jersey still offers sanctuary for a great variety of bird life and Cape May, at the southern tip of this state, is one of the outstanding areas in the United States to see and study the fall migration of birds. Ornithologist Witmer Stone's intimate descriptions of the area and its bird life were first published in 1937.

New additions to this excellent, unabridged, two-volumed reprint are an introduction by Roger Tory Peterson, a biographical sketch of Dr. Stone by James A. Rehn and a list, compiled by Ernest A. Choate, of additional species recorded in Cape May since the original publication. — D. R.

THE BIRD: Its Form and Function. By C. William Beebe. 496 pp., black-and-white photographs. Dover Publications, Inc., New York, 1965. $2.75.

Originally published in 1906, this unabridged, paperback reprint is still an excellent introduction to the history and physiology of birds. The late Dr. Beebe was well-known for his ability to write for the interest of the layman as well as the scientist. This publication is an excellent example of this ability. The preface is by Dean Amadon. — D. R.

MEN AND PANDAS. By Ramona & Desmond Morris. 223 pp., many illus. McGraw-Hill, New York, 1966. $7.95.

Dr. Morris was until recently Curator of Mammals of the Zoological Gardens of London and his wife is described as a professional historian. Joint authors of "Men and Snakes" and "Men and Apes," they have an even more surefire subject in the pandas, Red (or Lesser) and Giant, and they do them justice — ranging widely over the early history of both, their captivity history (with emphasis on the Giant Panda, naturally), the physiology of the Giant Panda and even (surely padding?) a chapter on "The Appeal of the Panda." There is a rather holier-than-thou chapter on "The Panda Killers," as if museum collecting (especially by Americans) were shameful and unheard-of, and an earnestly obtuse discussion of the Bronx Zoo's failure to obtain Mrs. Harkness's celebrated Su-Lin, the first Giant Panda brought out of China alive, which went to the Chicago Zoological Park. All in all, though, an excellent book, and the best and most complete one on pandas we are likely to get for some time.

William Bridges

ITS GOING TO BE A

Sprightly Spring

IN THE ZOO AND AQUARIUM

And so we're planning special programs for Members' children and Curator-conducted tours for Members on Saturday mornings in April and May. Members will soon receive a special notice about these events in the mail. The following schedule is advance notice to allow for the saving of these important dates.

PROGRAMS FOR MEMBERS' CHILDREN

(for Members, their children, and even a friend or two)

April 22 **Zoo Morning**
Tours and talks

April 29 **Aquarium Program**
White whales, seals and sharks

May 6 **Children's Zoo and Animal Nursery**
Enormous fun for the younger children

CURATOR-CONDUCTED TOURS

(for one Member and one guest)

May 13 **Mammals**
General tour of the Zoo in tractor trains

May 20 **Birds**
Waterfowl and waterbirds – and there will surely be some young

May 27 **Reptiles**
The metabolism of snakes

Garden Party

Probably in June. Members will receive invitations in the mail well in advance.

Summer Workshops

Courses in natural history available to Members' children in grades 3 through 9. Applications should be sent to the Education Department, Bronx Zoo, New York, N. Y. 10460.

NEW YORK ZOOLOGICAL SOCIETY

590.673
A59

VOL. LXX, NO. 2, APRIL, 1967

animal kingdom

animal

MAGAZINE OF THE NEW YORK ZOOLOGICAL SOCIET

CONTENTS

Baboons, 34
By Patricia O'Connor

The Thornbird and Its Many-chambered Nest, 44
By Alexander F. Skutch

Focusing on Zoo Animals, 52
Photographs by Paul G. Kovac

Rarest of North American Turtles, 58
By Arsene Eglis

In This Issue, 62

Behind the Scenes, 63

Illustration Credits, 64

Publications of Interest, 64

Issued bi-monthly by the New York Zoological Society at the Zoological Park, Bronx, N. Y. 10460. Editorial and Subscription Offices at the same address. Title registered with the U. S. Patent Office. Subscription, $3.50 a year; single copy, 60 cents. Same rates for all foreign countries and Canada. Second-class postage paid at Bronx, N. Y. Send Form 3579 to Bronx, N. Y. 10460.

kingdom

VOL. LXX • NO. 2 • APRIL, 1967

ABOUT THE COVER

We confess that Brad House, chairman of the Zoo's mammal department, expressed some displeasure over our choice for a cover photograph, insisting that the solemn expression of the female Red Howler Monkey, presented to the Zoo by Mr. John Dunston of Trinidad, is not typical of her personality or that of her mate.

"They are," he stated, "active and vivacious."

We suspect these characteristics may be reserved for those occasions when Mr. House pays a visit to their quarters at the Zoo's Hospital; there, they receive special care that goes with a reputation as one of the most difficult species to maintain in captivity.

Actually, this reputation is shared by all the howlers, of which there are five species, ranging from southern Mexico to northern Argentina. Largest of the New World primates, the howler, like the Woolly and Spider monkeys, possesses a tail that is strongly prehensile, but its voice, described as "like a distant storm, echoing tremendous winds and crashing trees," is totally its own.

The photograph is by the Zoo's Bill Meng.

NEW YORK ZOOLOGICAL SOCIETY
630 Fifth Avenue, New York, N. Y. 10020

President
Fairfield Osborn

First Vice-President;
Chairman, Executive Committee
Laurance S. Rockefeller

Vice-President
Henry Clay Frick, II
Robert G. Goelet

Secretary
John Elliott

Treasurer
David Hunter McAlpin

Assistant Treasurer
Eben W. Pyne

BOARD OF TRUSTEES
(*Executive Committee**)
Alexander Aldrich, George F. Baker, Jr.*, Robert E. Blum, William R. Coe, C. Suydam Cutting, John Elliott*, Charles W. Engelhard, Henry Clay Frick, II*, Robert I. Gannon, Peter R. Gimbel*, Robert G. Goelet*, Peter Grimm, John N. Irwin, II*, Warren Kinney, Anthony D. Marshall, Otto Marx, Jr., David Hunter McAlpin*, Peter Matthiessen, G. W. Merck, Charles W. Nichols, Jr., Fairfield Osborn*, Augustus G. Paine, II, Howard Phipps, Jr., John H. Phipps, John Pierrepont*, Eben W. Pyne, Laurance S. Rockefeller*, David T. Schiff, John M. Schiff, Henry Sears, Chauncey Stillman, Joseph A. Thomas, Landon K. Thorne, Jr., Alfred G. Vanderbilt, Robert Winthrop.

Ex-Officio:
The Mayor of the City of New York, Hon. John V. Lindsay
Administrator of Recreation and Cultural Affairs, August Heckscher

General Director
William G. Conway
John Tee-Van, *Emeritus*

ZOOLOGICAL PARK
William G. Conway, *Director & Curator of Birds;* Charles P. Gandal, *Veterinarian;* Hugh B. House, *Assistant Curator & Chairman, Mammals;* Grace Davall, *Assistant Curator, Mammals & Birds;* Joseph Bell, *Associate Curator, Birds;* Herbert J. Knobloch, *Curator, Education;* Charles B. Driscoll, *Superintendent, Operations;* Edward Kearney, *Manager, Facilities Dept.;* Lee S. Crandall, *Zoological Park Consultant & General Curator Emeritus;* Roland Lindemann, *Consultant, Mammal Management;* John M. Budinger, *Consultant, Pathology.*

AQUARIUM
Ross F. Nigrelli, *Director;* Robert A. Morris, *Associate Curator;* Lars Mellkvist, *Assistant Superintendent;* Jewell Bungay, *Business Manager;* Louis Mowbray, *Research Associate, Field Biology;* Christopher W. Coates, *Director Emeritus.*

OSBORN LABORATORIES OF MARINE SCIENCES
Ross F. Nigrelli, *Director & Pathologist;* Martin F. Stempien, Jr., *Assistant to the Director;* Klaus Kallman, *Geneticist.*

INSTITUTE FOR RESEARCH IN ANIMAL BEHAVIOR
(Operated jointly by the Society & Rockefeller University)
Donald R. Griffin, *Director;* Peter R. Marler, Jocelyn Crane, Roger S. Payne, Richard L. Penney, Fernando Nottebohm, George Schaller, Thomas T. Struhsaker, C. Alan Lill, O. Marcus Buchanon, *Resident Director, William Beebe Tropical Research Station.*

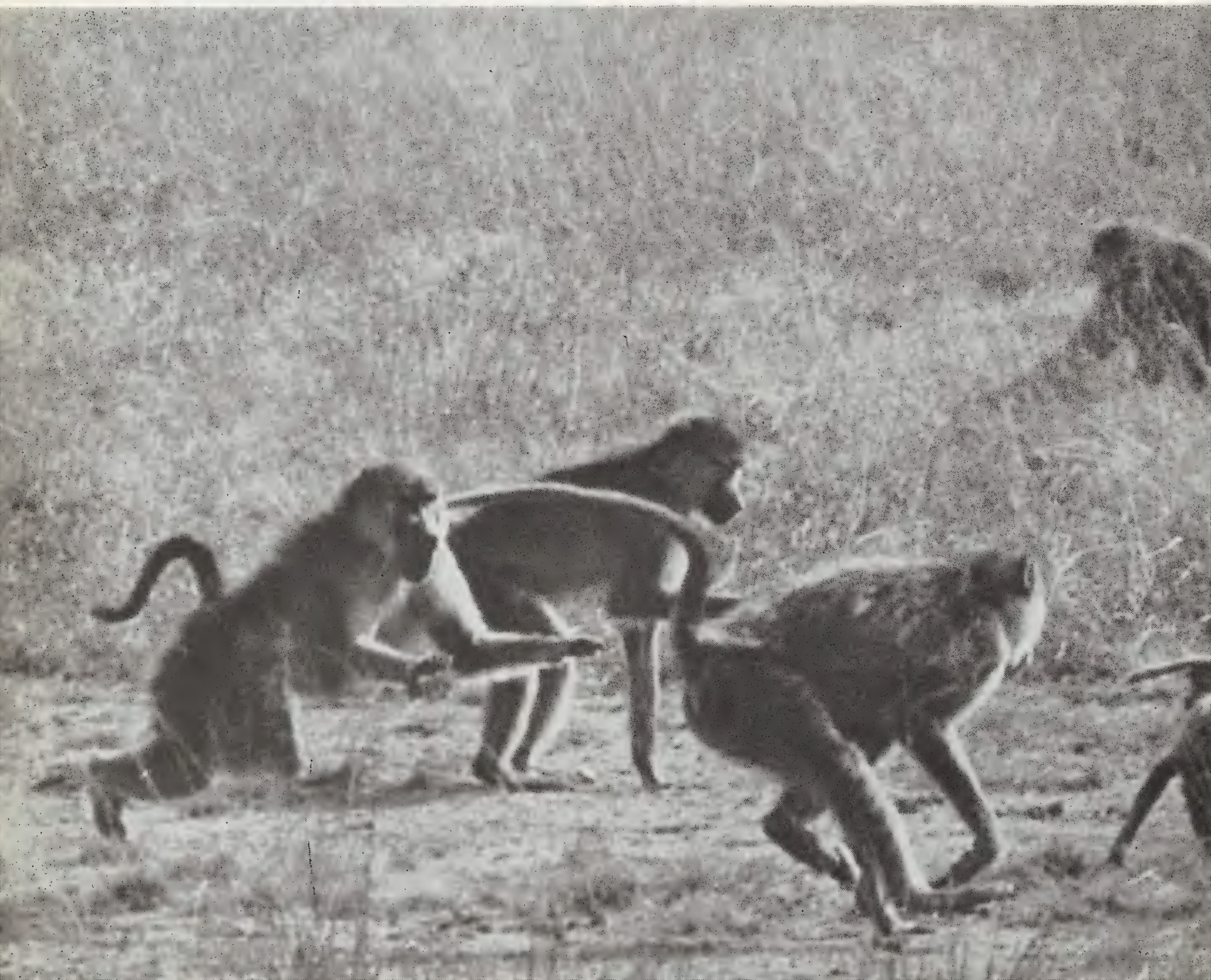
GENERAL
Walter Lerchenfeld, *Comptroller;* Harold C. Palmer, *Assistant Secretary;* John McKew, *Personnel Manager & Assistant to the Director, Zoological Park;* Gordon Cuyler, *Membership Chairman & Administrative Associate;* Jerry M. Johnson, *Curator, Department of Exhibition and Graphic Arts;* John L. Miller, *Editor & Associate Curator, Publications;* Dorothy Reville, *Assistant Editor;* Sam Dunton, *Photographer.*

AFFILIATE
Jackson Hole Biological Research Station
L. Floyd Clarke, *Director.*

BABOONS

By PATRICIA O'CONNOR

The Yellow Baboon is probably the most widely distributed primate on the African continent and is adapted to a great variety of habitats. This active troop was spotted in Kenya's Amboseli Reserve.



"DROP DEAD, YOU BIG BABOON!" jeered a frail teenager at his burly pursuer as he nimbly scrambled up the front steps of his home and leaped safely inside. The smaller youngster had hurled the insult only because he was confident of his own agility in fleeing from his physically formidable antagonist.

But why did he choose to call his opponent a "baboon?" Why not a moose, or an elephant, or a kangaroo? Had the name-caller ever seen even a photograph or a drawing of a baboon much less a live specimen?

The chances are that he had not, for the expression "big baboon" is about as common as "monkey's uncle" and just as meaningless when applied in human terms.

Still, if the youngster could have known there are eight distinct species of baboons, which one would he have chosen to characterize his adversary? Perhaps the Mandrill, *Mandrillus sphinx,* might be most appropriate for his purpose because it is unquestionably the strangest admixture of grotesque embellishment and visual ferocity that one could possibly imagine. Its colorful face is one of the weirdest in the entire animal world, almost too incredible to believe even when seen. On each side of its huge protruding snout are two swollen masses of oblique, bony and deeply grooved ridges that are decorated with a brilliant azure blue while the grooves themselves are a deep purple. The center section between the blue swellings, which extends over the tip of the nose, is a bright scarlet surrounded by yellow whiskers. This spectacular color effect is balanced on the overdeveloped buttocks by hairless seat pads (ischial callosities) that blend from a ruddy violet to a vivid red and,

This superb male Mandrill has become the great attraction in the Bronx Zoo's Monkey House, where he has lived for nearly 9 years and has sired 7 young. The facial skin is colored in vivid hues of blue, purple and scarlet. Females of the species are much less colorful.

to top it off, a five-inch-long tail which is constantly held in a pert upright position. The body fur is olive-brown, fading into gray on the underside of the limbs. An adult male may stand three feet high and weigh over 100 pounds. Female Mandrills are only half as large and not nearly so colorful, having only the blue tint on the muzzle but of a much less brilliant hue. The immature males have less pronounced ridges on their snouts and do not attain the spectacular adult coloration until they are eight years old. Occasionally they breed in zoos and have a gestation period of 220 days. In captivity Mandrills have lived as long as 40 years.

The second member of this genus, the Drill, *Mandrillus leucophaeus*, has a shiny, jet-black face with elevated cheekbones that form a "V"

bisected by a long, thin nose ridge. Its face is surrounded by a deep fringe of fur sticking outward in all directions and there is a wedge-shaped central topknot that extends forward to just above the eyebrows. Male Drills are, of course, much larger and more powerful than the females and grow to a height of three feet. Old males are said to be shy in the wild state but they are dangerously aggressive in captivity and much stronger than a man of the same weight.

These two ground-dwelling species, Drills and Mandrills, are found in two rather limited dense forest areas of equatorial West Africa: one is in the northern Cameroons between the Cross River on the eastern border of Nigeria in the west and the Sanaga River in the south, and the other is from the Sanaga south throughout the southern Cameroons and Gabon to the Congo.

The young of both species are often very difficult to tell apart. Young Drills have only one large ridge or crease on either side of the midline of the muzzle, while baby Mandrills have several small ridges on either side.

Each species travels about in tribal groups, hunting for food by turning over logs in search of worms, lizards, frogs, snakes, mice and other small animals and by digging for succulent roots and bulbs. The males travel at the outer edges of the group, apparently in order to protect the females and their youngsters. At the least sign of danger they growl, open their mouths in a yawn-like gesture baring their enormous fangs. In common with many other species of baboons, they appear to have a definite mode of communicating in a curiously varied language of intonations such as short, sharp barks, prolonged howls and sudden screams, quick jabberings and even special gestures of the limbs. There actually seems to be a genuine system of military telegraphing by means of these sounds and signals.

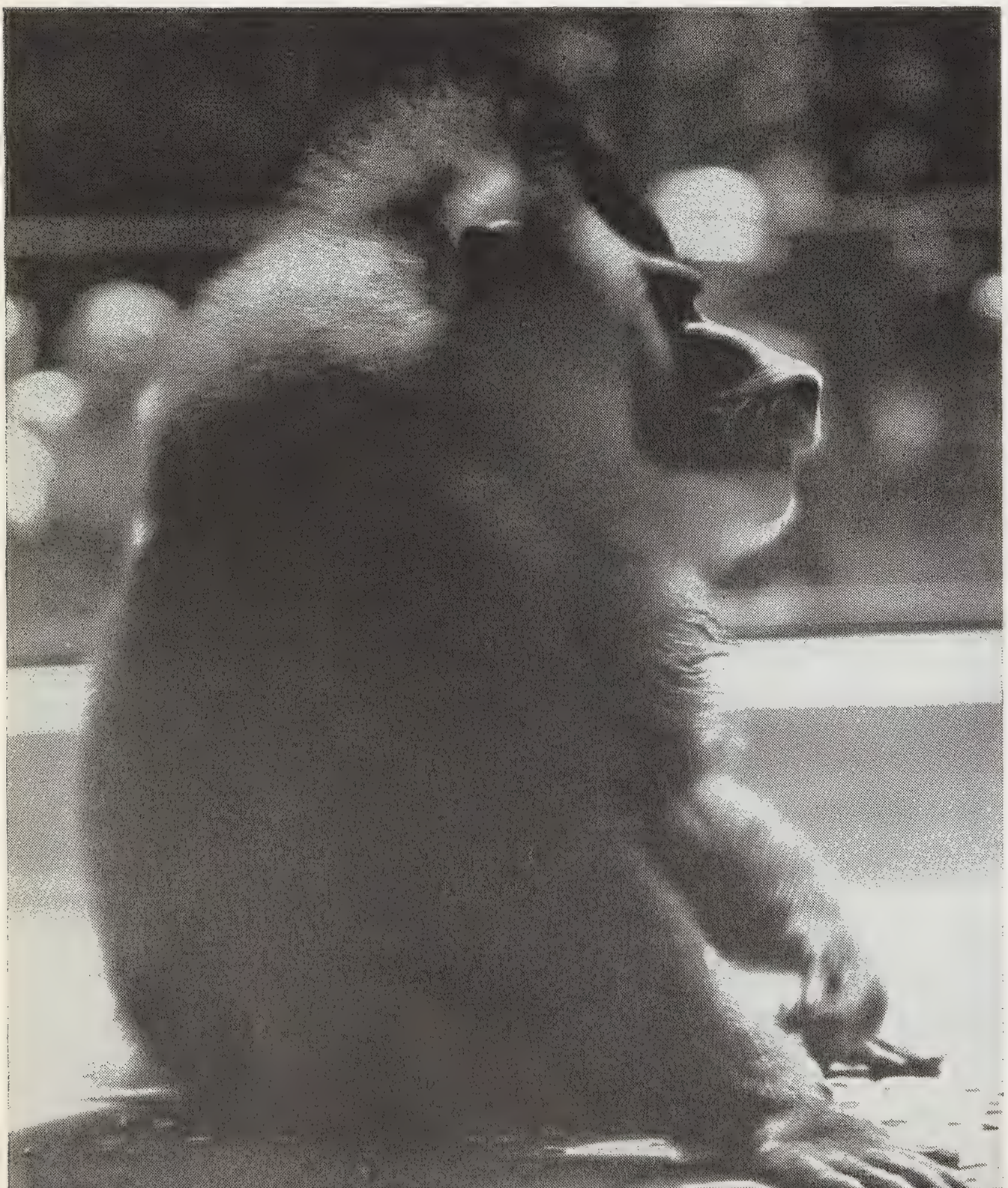
In her book "Almost Human," Julie Macdonald states that perhaps the language of the Hamadryas Baboon, *Comopithecus hamadryas*, was largely responsible for the Egyptian deification of this animal. The belief that the baboon possesses a secret language, and the veneration of these creatures as Toth — the god

It takes about 8 years for a male Mandrill to attain the spectacular coloration of full adulthood. This youngster is an offspring of the big male, opposite. The object he so delicately holds is a single hair.

who had the head of an ibis and was considered the lord of wisdom, inventor of language and patron of the scribes — could very well stem from the early Egyptians familiarity with the baboon's vocalizations.

In ancient times the Hamadryas Baboons were indigenous to the entire Nile Valley and held a very unique and honored place in Egyptian civilization. They were regarded as beings somewhat superior to mere man, with a direct line to the Gods — a sort of non-human priest class. In accordance with this status they were allowed many privileges during life and the honor of mummification after death.

Yet despite their sanctity these baboons were frequently put to work by Egyptians. First they had certain religious duties to perform which included morning prayers at the temples. However, they were assigned more menial tasks such as sweeping out the temples, running errands and even waiting on table! Although these activities may sound rather far-fetched, it must be remembered that the Hamadryas Baboon was more closely integrated into human life than any other animal in history, not excluding even the dog.



In their natural state these same baboons are ruffians of the first order, fully tribalized and extremely aggressive. However, in 1960 and 1961, Dr. H. Kummer of the University of Zurich studied the precise details of the group structure and individual spacing of four troops totalling over 1,000 wild Hamadryas Baboons in the region of Erer-Gota and Dire Dawa in Ethiopia. Studies of social behavior were mostly limited to a typical troop averaging 137 individuals. He observed that the most constant unit among these animals was not a troop, but rather a "one-male group" consisting of an adult male and usually one to four females who follow this leader as their sex partner. Males threaten their females as soon as they separate themselves more than four yards.

These harems do not come in contact with each other except en route to and from the sleeping lair where they join in sleeping groups averaging nearly 100 individuals. A total of 70 patterns of social behavior in the wild state were observed and compared to similar patterns previously observed among the colony of 15 specimens in the Zurich Zoo. Dr. Kummer concluded that captive baboons spend much more time in social activities such as grooming and that juveniles retain their subadult behavior much longer than those in the wild.

The huge Gelada Baboons, which inhabit the high mountainous regions of Ethiopia to an elevation of 8000 feet, are placed in a separate genus, *Theropithecus,* with two species, *T. gelada* and *T. obscurus* differing chiefly in coat color. Fossil bones of these species have been found in the Pleistocene formations in India and South Africa. Their massive bodies are clothed in long, black, plume-like hair that forms a great mane over the neck and a cape that may reach almost to the ground. The buttocks pads are black and the long thick tail has a tuft of fur at the end. The underparts of the body are lighter in color, usually grayish or grayish white. Geladas are easily distinguished from other baboons by their round heads, pug faces and upturned nostrils which open on the sides of the nose instead of terminally as in the other species. There are large ridges running from below the outer side

Adult male Drills (left and above) have a shiny, jet-black face with elevated cheekbones that form a V, bisected by a long, thin nose ridge. The face is ringed by a fringe of fur sticking outward in all directions.

The hair of the Hamadryas Baboon is long, stiff and silver-gray. In adult males (above) the hair stands above the head and grows long over the shoulders. Ancient Egyptians considered the Hamadryas sacred.

of the eyes to a point on either side of the nostrils. They have vivid, white eyelids and, most extraordinary, are their naked red chests which form a prominent heart-shaped pattern. In intramenstrual periods, the females develop peculiar "necklaces" composed of strings of globular swelling in loops around their necks and across their chests.

In their native state Gelada Baboons retire into caves and rocky crevices at night, and when they emerge in the morning they sometimes sun themselves for several hours before becoming active. They travel in large groups, apparently made up of family units which are led by several adult males. The males are twice the size of the females and are equipped with incredibly long canine teeth. The groups may mingle during the day but retire to separate quarters at night. A warning of danger given by a sharp bark causes the troop to unite immediately and, if necessary, to return to their rocky shelters. Like many other primates, Geladas may throw stones or deliberately roll

rocks down hillsides at their enemies. In the wild the young are said to be preyed upon by Kaffir Eagles, but in a zoo environment many Gelada babies are raised successfully.

Except for the Mandrills and Drills, baboons are non-forest dwellers and they range from the extreme western bulge of Africa clear across the continent to the upper Sudan and Ethiopia, and south down the eastern half of the continent to the Cape. Avoiding the Rain Forest, they inhabit all manner of open forests, savannas, scrub and even desert, but they especially prefer rocky eminences on the lowlands, plateaus and in true mountains.

The genus *Papio* includes four species: the Yellow Baboon, *P. cyanocephalus,* the Chacma Baboon, *P. ursinus,* the Western or Guinea Baboon, *P. papio* and the Olive Baboon, *P. doguera.* The Chacma Baboon gets its name from the contracted form of the Hottentot word "Tchakamma." Adults are 32 inches long with a 14-inch tail and are native to eastern and southern Africa. They do not become fully mature until eight or nine years of age. In raiding cultivated areas for food this species is unbelievably bold and can slip past sentries or watchdogs without making the slightest sound. They are alleged to pass the stolen fruits from one animal to another like a bucket brigade. Young Chacmas are often kept as pets in regions afflicted by droughts, for it is believed that they are unerring water diviners. To accomplish this purpose the baboon is deliberately deprived of water and fed salty foods and then allowed to wander about at the end of a long rope until it picks a spot and begins digging vigorously and locates a source of water.

Geladas are distinguished from the other species by their round head, pug face with upturned nostrils, and by their red, hourglass chest patch. Females (above) are considerably smaller than males (below).

An adult male Chacma Baboon grooms a female as she nurses her baby. Raiding cultivated areas for food, Chacmas are said to be unusually bold, slipping past sentries and watchdogs without a sound.

The Yellow Baboon, *Papio cyanocephalus*, is probably the most widely distributed of all species of primates in Africa and is adapted to a great range of habitats. In the southwestern section of the continent they are found ranging over an arid thornveld where edible vegetation is extremely limited, and where temperatures vary from 80° F. during the day to below freezing at night.

In 1959, Dr. Irven DeVore in a 10-month field study made a census of all the troops of Yellow Baboons in, and adajacent to, the 40 square miles of the Royal Nairobi National Park. He and his aides spent more than 800 hours in observing closely more than 2,000 baboons. In 1963, a second study was made on the population structure of these same groups. According to his estimates there had been a population increase of 40 per cent in four years.

Wherever baboons have been studied they have shown consistent patterns of group size, range, social organization, dominance behavior and vocalizations. Observations on the Olive Baboon of the Nairobi highlands and the Yel-

low Baboon of the Kenya lowlands and coast showed that troops vary in size from 10 to 200, the average troop numbered 43 at Nairobi and 80 at Amboseli.

The social organization of the groups is characterized by degrees of dominance and subordination among the adult and subadult members of the troop. A female with a young infant is so completely protected by adult males that she is virtually immune to any antagonism from the rest of the group.

The gestation period is five to six months, and immediately following the birth of the infant the mother moves to the center of the group, close to the dominant males. The older males show much more interest in the newborn infants than do the young males which walk at the outer edge of the troop providing an extra zone of protection against any predators.

At first the relation between the mother and her baby is constant and intense. Grooming is the most important time-consuming activity in a baboon's social life. During the first 10 days of its life, an infant receives its mother's undivided attention which includes intensive grooming, nursing and lip-smacking.

Within a few hours after its birth the baby is capable of clinging to its mother without any support from her. At three weeks of age the infant will sit between the mother's legs without holding on, but when she gets ready to move, she grasps the baby to her abdomen, and runs off without giving it any further support. Most infants occasionally ride on their mother's back when they are five weeks old.

Scientists engaged in a variety of human health studies have long recognized the importance of subhuman primates for research. The Russians have kept baboons in their Sukhumi Research Station since 1927. More than most other laboratory animals, baboons are similar to man in physiological, psychological and even social responses. In addition, baboons are readily available in large numbers, for, unlike monkeys, there are no religious, moral or political prohibitions restricting their capture and use.

In 1957, the Southwest Foundation for Research and Education in San Antonio, Texas, started a small baboon colony of this animal as a research model. This has now developed into the largest baboonery in the world, and each year since 1963 it has sponsored an International Symposium at which papers are presented describing current research on baboons in the fields of physiology, biochemistry, pathology, behavior, and experimental medicine. Perhaps from these studies we may eventually learn that our young friend who called his opponent a "big baboon" was on the right track after all!

A male Olive Baboon in his prime bares the impressive canines at another male in a typical threat posture. Blinking of eyelids often accompanies display. Troops averaged over 40 in Nairobi highlands.

THE THORNBIRD AND

...S MANY-CHAMBERED NEST

BY ALEXANDER F. SKUTCH

As WE SPED ALONG the four-lane super-highway from Caracas to Valencia, we noticed great oblong masses of interlaced sticks hanging conspicuously from trees by the roadside and in the surrounding fields. "Those," said my companion and guide, Paul Schwartz, veteran photographer of South American birds and recorder of their voices, "those are nests of the bird you have come to Venezuela to study, the Rufous-fronted Thornbird." We saw scores of such nests, some even on service poles, before at last I glimpsed one of the little, wren-like, brown birds that build them. To study nests that are easier to find than the birds that make them would be a novel experience. Locating the nests of tropical birds, even of those that in one way or another make themselves conspicuous, is usually a difficult matter, involving much patient hunting through forests or thickets.

The Rufous-fronted Thornbird (*Phacellodomus rufifrons*) is a member of the Furnariidae or ovenbird family, whose 209 species inhabit South and Central America and tropical Mexico. Nearly all of these small or middle-sized passerine birds are clad in shades of brown, with occasional patches of warm chestnut or rufous to diversify their plain attire. But they compensate for their monotonous coloration by the exciting variety of their architecture; no family of birds has more diversified nidification. In Central America I had found nests of numerous species: great castles of sticks hidden in thickets; bulky globes of green moss hanging from trees and vines in the mountain forests; inverted pockets of moss skillfully fastened to mossy logs, or else smaller structures hidden in burrows in banks or holes in trees. Each of these nests was attended by a single pair of birds or, rarely, by a lone female. None of the Central American ovenbirds builds a prominently hanging structure of sticks that is the abode of a whole family, or perhaps of several families. Long ago I was fascinated by W. H. Hudson's too-brief accounts, in *Birds of La Plata*, of firewood gatherers and thornbirds whose great nests of sticks were apparently the permanent abode of the industrious birds that made them. Now, at last, I had come from Costa Rica to Venezuela to study the northernmost representative of this interesting group of ovenbirds.

Less than a week after our arrival in Venezuela, my wife and I were comfortably settled at "La Araguata," a large farm belonging to the bird artist Walter Arp, situated among the hills of the state of Carabobo, some 20 miles south of Valencia. On my first evening here I watched a bulky thornbirds' nest hanging from a tree in a fence line between pastures, close to the farm buildings. Nearby the Diesel engine that drove the electric generator was chugging noisily. Daylight, and my hope of finding this nest occupied, had all but died away when I heard repeated sharp *chips* coming from the weeds along the fence. Presently several thornbirds appeared, making their way through the low herbage toward the nest, undeterred by the engine's noise and pungent fumes or by my unconcealed presence. When near the nest they flew up to it, one after another, until I had counted six. They entered at

Rufous-fronted Thornbirds are plainly attired creatures but they compensate for dull coloration with an ability to construct many-chambered nests up to seven feet long and at tree heights of 12 to 50 feet.

least two of the rooms in the three-chambered structure, and when the last had vanished inside it was nearly dark.

The following morning, as it was growing light, I watched these six birds leave their dormitory. After flying down, they called a few times while travelling along the fence line toward the nearest thicket. Then, from amid low, dense vegetation along a neighboring stream, I heard their song, a rapid sequence of loud, ringing notes, all quite similar, except that sometimes the series ended with lower, mellower notes. In the weeks that followed, I came to love this simple performance, always so bright and animated, so suggestive of a cheerful nature. Often, especially while building their nest, the male and female duetted, standing side by side with bodies stretched up, bills pointing skyward, and downwardly directed tails beating time to their notes. Sometimes the song of one pair or family stimulated neighboring groups to raise their voices.

All day the thornbirds foraged, in pairs or family groups, through low thickets and weedy fields, where they were difficult to follow. Most of their food was gathered on the ground, where they hopped with feet together. Rather than flicking leaves aside in the manner of many ground-foraging birds, they pushed their heads under the litter to see what was there. Sometimes they quite vanished beneath dry fallen leaves, to reappear on the other side. They also investigated dead leaves caught up in bushes and vine-tangles, sometimes pulling out a leaf and dropping it. Like other ovenbirds, they subsisted largely, if not wholly, upon insects, their larvae and pupae, with an admixture of spiders and other invertebrates; I never saw them eat any fruit.

AFTER WATCHING the thornbirds make their way to the thicket where they foraged, I examined an old, fallen nest near the house. Composed of interlaced sticks, it was about 30 inches high by 10 to 14 inches wide, not including the ends of the sticks which stuck out far on all sides. It contained four more or less spherical chambers, placed one above the other in a single series, and separated from each other by partitions of sticks. The chambers did not intercommunicate, but each had its separate opening to the outside. The longest stick measured 21 inches. Those over 12 inches were numerous and ranged in thickness up to that of a lead pencil. Most of the sticks were fairly straight, but some were branched. At "La Araguata" there was abundant rainfall during the wet season, thus only a minority of the sticks used by the thornbirds were thorny. Doubtless in more arid regions, where the vegetation bristles with spines, the thornbirds gather enough thorny sticks to justify their name.

The fallen nest was an amazing construction for a bird only six inches long. Not the least surprising thing about it was the lining. In the four compartments I found scraps of cellophane, fragments of paper, bits of tinfoil, colored candy wrappers, and pieces of plastic bags up to six inches square, as well as feathers, narrow strips of fibrous bark, flakes of stiff bark, brown vegetable fibers, and chips of wood. Nests built farther from human habitations are lined chiefly with fibrous or papery materials from wild plants, curved rachises of compound leaves, and the like. Often they contain scraps of snakeskin. The Venezuelans say that the place to look for a lost love-letter is in the nest of "guaití," as the thornbird is called.

The four-chambered structure was a nest of moderate size. Newly-completed nests commonly contain two compartments, one above the other. The upper one may remain for a good while unfinished, with a loose covering of sticks; occasionally it is still uncovered when eggs are laid in the lower chamber. In other cases, the birds continue to build until they have started a third room above the second. Then, after a rest, they add new chambers from time to time. The limit of size seems to be set by what the usually slender supporting branch will bear. Sometimes the bough snaps under the growing weight, and sometimes an angle or sharp curvature makes further upward extension impracticable. It was doubtless no accident that the tallest nest we saw was attached to a long, slender, dangling vine that seemed to invite the thornbirds to build up and up. This inaccessible nest was estimated

to be seven feet high and to contain eight or nine chambers, with as many doorways, all facing the same way. Other shorter nests are more massive; one exceptional structure contained two compartments side by side in the top but only one below. Some thornbirds' nests are said to weigh hundreds of pounds.

ALTHOUGH thornbirds forage in thickets, they prefer their nest site in a tree standing in the open, in a pasture, a cultivated field, a dooryard, or beside a road. The tree may be separated from the nearest thicket by 50 yards of open ground, over which the birds fly rapidly when approaching or leaving their home. If no isolated tree is available, they build on the more exposed side of one growing at the edge of a woods or thicket. The slender, leafy branch chosen for the attachment of the structure may be horizontal or even upwardly inclined, but far more often it slants downward, and it may even hang vertically. As the weight of the nest increases, the branch sinks, and often the foliage drops off, so that the larger, older nests, which most often catch the attention of the hurried traveller, generally swing from vertically descending naked boughs, giving a false impression of the kind of site the thornbirds habitually choose. Most of the nests that I saw were from 12 to 50 feet up, the extremes being seven and about 75 feet. Since the structure is built around the branch, embedding it in the wall of sticks, it rarely falls unless the supporting branch breaks off or the sticks decay.

Often I watched the thornbirds build. Nearly always they worked in pairs, the two taking equal parts; sometimes a third bird gave much help, and occasionally there was a suggestion that a fourth was contributing. They built most actively early in the morning, after an interval for breakfast. Soon tiring of their arduous toil, by the middle of the morning they were ready to rest, but later in the day they built sporadically, and frequently they worked a little just before retiring in the evening. Although occasionally the birds tried to break twigs from trees, only small ones well advanced in decay yielded to their effort. Most of their sticks were gathered from the ground, seized, always singly, near the middle in the bird's slender bill. At times the builder flew directly up to the nest with its burden, but the heavier the piece, the more likely it was to hop and flit upward through neighboring shrubs and trees, showing great skill in maneuvering a stick two or three times its own length past obstructing branches. After attaining a point level with the nest or even above it, the bird flew across the intervening open space, sometimes with a load so heavy that it could hardly remain airborne. The thornbirds showed indomitable perseverance in carrying the sticks to their nest, often following to the ground one which fell and raising it again by a circuitous route.

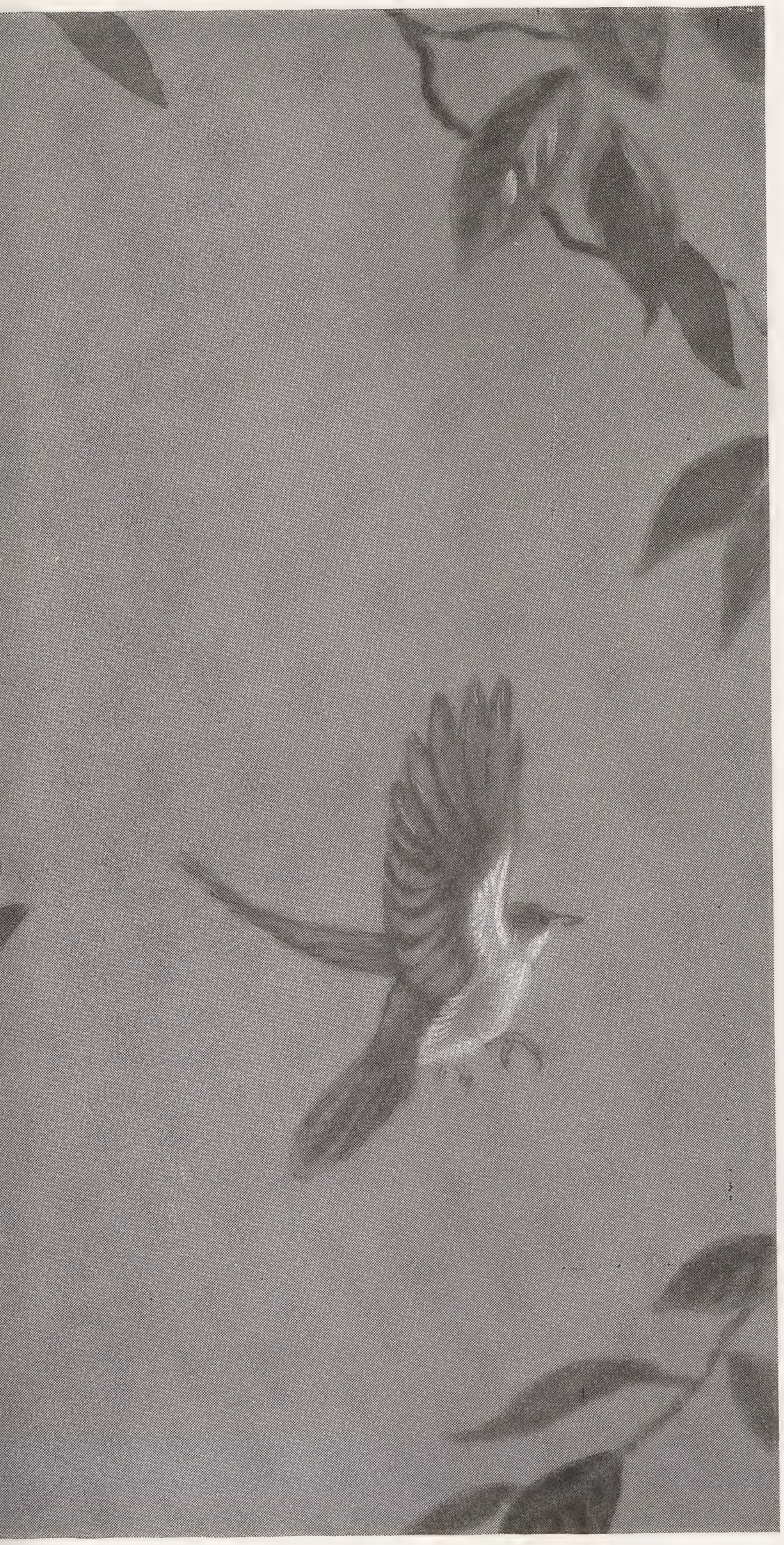
Reaching the growing nest with a stick, the builder held it with one end lower than the other and made sideward, apparently random movements with its head until the nether end slipped into a space between the other sticks. If the stick did not fit tightly, it might be pulled out and placed somewhere else. After depositing a new stick, the bird often tested a number of others, tucking in more firmly those that were loose. Even after the eggs were laid, the thornbirds continued to inspect their nest and push in falling sticks. Thus, by a simple technique, and without any cement of binding material, they made a fabric so strong that I could hardly open it with my fingers. To see the eggs or nestlings in the well-enclosed chamber, I forced a stout, pointed stick through the wall, making a hole large enough to insert a small electric bulb and mirror. After each visit of inspection, I closed the orifice.

Building thornbirds had no special time for lining their nests. If they found a feather or some other attractive material while their structure was still an open platform, they would deposit it there. While incubating their eggs, they brought much additional lining, and occasionally they brought a piece while feeding nestlings.

From March to May, before any nestlings had fledged, I made a census of the thornbirds' nests in the vicinity. In each of three nests, six grown birds slept nightly. One nest had five occupants, and in another I found sometimes four and sometimes five. There were

three nests with three sleepers. Fourteen nests, or 64 percent that I investigated, were inhabited by a single pair.

How did the larger groups of thornbirds arise? To answer this question, it was necessary to study their breeding habits. Although a number of flycatchers, tanagers, and other birds that gathered their food in the air or amid foliage nested at the height of the dry season in March and April, thornbirds, as is usual with ground-feeders, waited until the returning rains had soaked the ground litter and vitalized the small creatures that live in it, thereby providing an abundance of food for the nestlings. One pair established on low, damp ground was already feeding nestlings when the weather turned wet in mid-May, but most thornbirds delayed laying until late May or June. The few sets that I could reach consisted of three eggs, which were pure white, as is usual with ovenbirds. The eggs were nearly always laid in the lowest compartment, even when the nest contained newer chambers at the top.

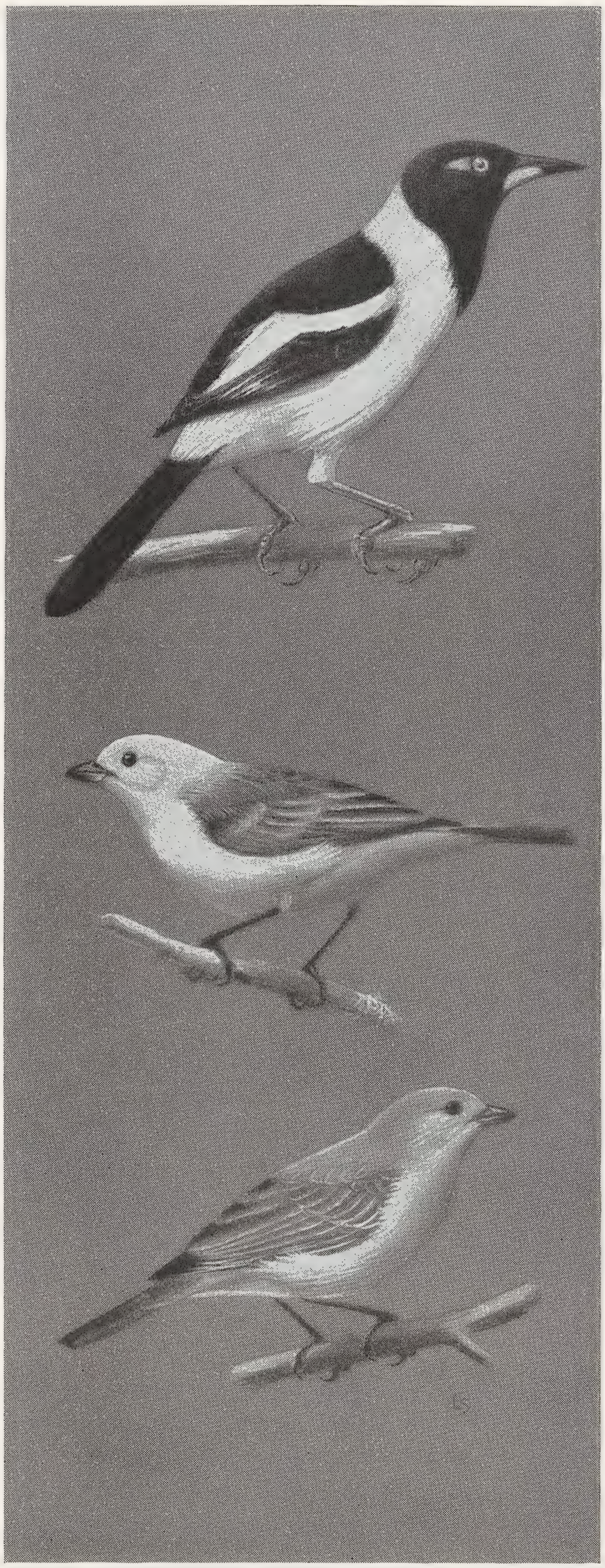


The Troupial—the black, white and orange oriole that is Venezuela's national bird—appears to be most injurious to thornbirds; tearing wider holes, it often will take over a thornbird nest for its own use.

One breeding pair consisted of a normal bird with a mate who remained quite tailless for four months. Since the sexes of thornbirds are not readily distinguishable, this provided an unusual opportunity to learn the parts each parent took in caring for the eggs and young. During incubation they replaced each other frequently, rarely sitting as long as 50 minutes at a stretch, but between them keeping their three eggs covered most of the time. As one relieved the other, they often joined in a duet, and while sitting in the nest, they sometimes sang loudly. Their eggs hatched after 16 or 17 days of incubation. As at other nests, the mated pair always slept together in the chamber with the eggs and nestlings.

Both parents brooded and fed the pink-skinned, sparsely-downy nestlings, bringing many small, brown pupae as well as green caterpillars, small grasshoppers and other insects, and occasionally a spider. On each parental visit only a single article was brought, held conspicuously in the tip of the bill. The parents worked hard, feeding three nestlings, about 12 days old, 255 times in the course of an active day of nearly 13 hours. Although the nestlings were fairly well feathered at this age, they remained in their swinging nursery another ten days. When finally they left, at the age of 21 or 22 days, they were as large as their parents and resembled them closely. On their very first flight they covered 100 feet with good control.

In the evening of the fledglings' first day in the open, the parents led them back to sleep in the nest. The young evidently continue to lodge with their parents until the following breeding season, or even longer. Since some pairs raise two broods in a season, a family group of seven or eight might grow up, if there were no losses. Thornbirds are so strongly territorial that two pairs and their descendants are not likely to occupy the same nest, even when it contains four or five rooms. When more than two grown birds sleep in a nest they are normally parents with their self-supporting offspring, but this is not the whole story. Thornbirds who have lost their nests sometimes seek admission to those of other families. Since the owners of these nests repulse them, they wait outside until it is nearly dark, then force their way in at a time when the resident birds probably cannot distinguish the intruders from members of their own family.



The Troupial (top) will evict a thornbird from its nest, while the Blue Tanager (middle) and the Sayaca Tanager (below) will take over an abandoned or partially abandoned thornbird nest for their own.

These interlopers are sometimes exceedingly persistent in their demand for a night's lodging. When a branch overladen by a large nest snapped off, the four tenants were left homeless. Two disappeared, but the mated pair promptly started a new nest in the same tree. While building, they had no roof to shelter them on rainy nights, so the nest of a neighboring pair was sought. One member of the homeless pair pushed in against strong opposition, after the moon and stars were shining brightly, but the other, more timid, preferred to sleep on the still roofless new nest. This continued for several nights, and the intruder developed a maneuver to meet the situation. When repulsed at the doorway, it turned its tail to the hostile birds inside, repeating this in the failing light until, it seemed, the ones within grew drowsy and permitted it to enter.

Nests so large and commodious as those of the thornbirds are coveted by less industrious birds of other kinds. Among those that have been found breeding in them are the Saffron Finch, Blue Tanager, Sayaca Tanager, Troupial, Piratic Flycatcher, and Firecrowned Flycatcher. Of all these birds, the Troupial — the melodious, black, white and orange oriole that is Venezuela's national bird — appears to be the most injurious to the thornbirds. Although most of the other secondary tenants of thornbirds' nests breed in them only occasionally and may be satisfied with old abandoned nests or dilapidated parts of nests, the Troupial regularly takes over wherever the two species occur together. Moreover, it demands a sound chamber, perhaps one still occupied by the thornbirds. Much larger than the builders, it cannot use their doorway but tears a wider opening in the side of the chamber, an undertaking for which its finely pointed bill seems far too delicate. While raising a single brood, a pair of Troupials stole three thornbird nests, one of which contained eggs and another nestlings. In one of these nests the female Troupial laid three eggs, after lining the chamber more adequately than the thornbirds had done. The other two stolen nests were used as dormitories by the adult Troupials, who always slept singly. Although thornbirds may continue to lodge in another chamber of a nest occupied

by Troupials, I doubt whether they could raise a brood so close to these aggressive intruders.

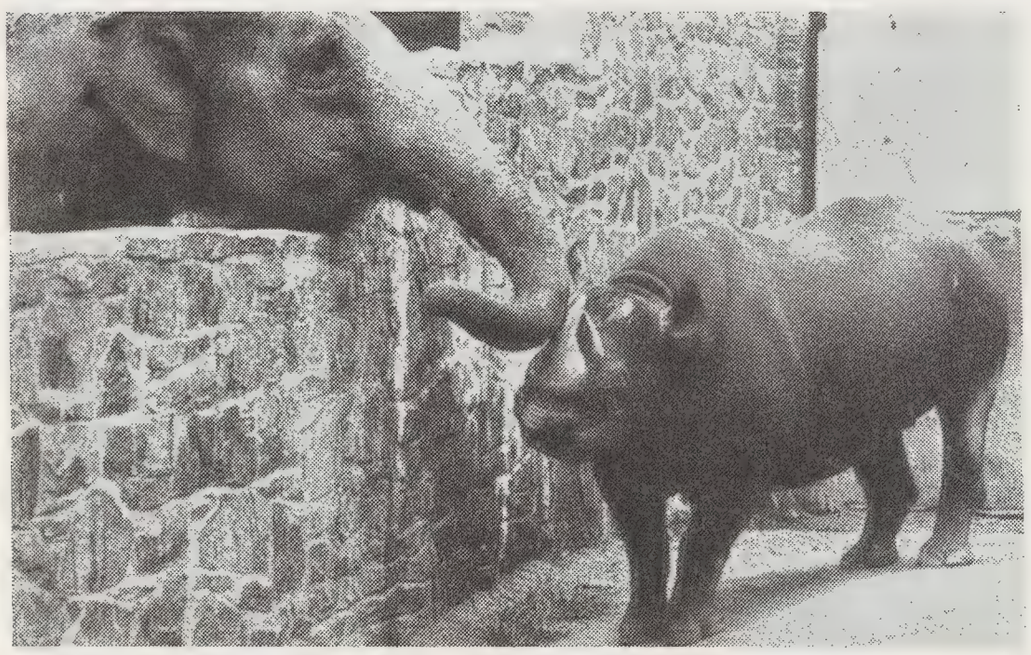
Many-chambered nests, occupied by a number of breeding pairs, are built by the Social Weaverbird of southern Africa, the Palm-Chat of Hispaniola, and the Gray-breasted Parakeet of southern South America. It was natural to assume that the large nests of thornbirds were also avian apartment houses, but this proved wrong; the territorial thornbird does not admit such close neighbors. Why, then, almost alone among the birds of the world, do single pairs build nests with two or more compartments? The answer is that the upper chamber sometimes serves as a bedroom for the older young while the parents attend eggs or nestlings; although the older offspring may try to join the parents in the brood chamber, they are at times violently repulsed.

The additional compartments may also make it more difficult for predators to find the eggs or nestlings. While incubating or attending young, the parents enter empty compartments with confusing frequency, so that often one must watch a long while to learn the exact location of the eggs or nestlings. Flightless mammals or reptiles, approaching along the supporting branch, come first to the usually upper chambers. Even if their failure to find anything edible here does not cause them to abandon the search, the delay may give feathered nestlings time to escape from the lowest compartment. And in the event of a night attack, such a delay might save the sleeping adults from being surprised and eaten. Nevertheless, many thornbirds lose eggs or nestlings to predators such as arboreal snakes slender enough to enter their nests without tearing open the wall.

But whatever practical advantages the nest with several chambers may have, I do not believe they provide the whole explanation of why the thornbirds construct them. In the ovenbird family, as among wrens, there is a strong tendency to build superfluously as a pastime or outlet for excess energy. In the Rufous-fronted Thornbird, as in certain related species, this propensity has reached its highest point.

Top-to-bottom—Piratic Flycatcher, Fire-crowned Flycatcher and Saffron Finch are among several species of birds that take over deserted thornbird nests for either temporary shelter or seasonal housekeeping.

FOCUSING ON ZOO ANIMALS



Photographs By PAUL G. KOVAC

WOULD YOU BELIEVE that mere "weekend ramblings" with a camera at the Bronx Zoo produced the unusual photographs shown on these pages? And would you believe that during the week (Monday-Friday) Paul G. Kovac is a financial analyst with a well-known Wall Street investment house?

Now come the weekends (Saturday-Sunday) and Mr. Kovac slips quietly away from his friends and associates, put on a dark blue beret, slings a Nikon F over his left shoulder, and heads for the Bronx Zoo.

He is but one of millions of people who, every year, bring their cameras, lenses, filters and tripods to zoological parks throughout the United States and the rest of the world. Not all of them have Mr. Kovac's ability, and many of them carry Brownies, but they all share his interest in animal photography.

Like several other excellent amateur photographers who frequent the Zoo, Paul Kovac has great imagination and ability—ability that includes a willingness to learn to understand his animal subjects and the patience to wait them out, which in some cases (our wolves, for instance) may mean hours or even days.

Most zoos welcome photographers for a number of reasons, among them the sale of film. The San Diego Zoo, for example, sells over $100,000 worth of film and photographic supplies a year. But far more important is the interest that amateur photographers take in wild animals and often in the conservation of the world's endangered species.

Zoos need good friends, and some of our best friends at the Bronx Zoo are the photographers who, like Paul Kovac, visit the Park.

Mr. Kovac took these pictures with his Nikon F equipped with either a Nikkor 105 mm f2.5 lens or a Nikkor 200 mm f4.0 lens. The film was Tri-X.

A zoological park bursting with photographic subjects—an elephant and a rhinoceros visiting over a wall; a composition of Dalmation Pelicans; a contemplative Jaguar, and the pattern of a Grevy Zebra.

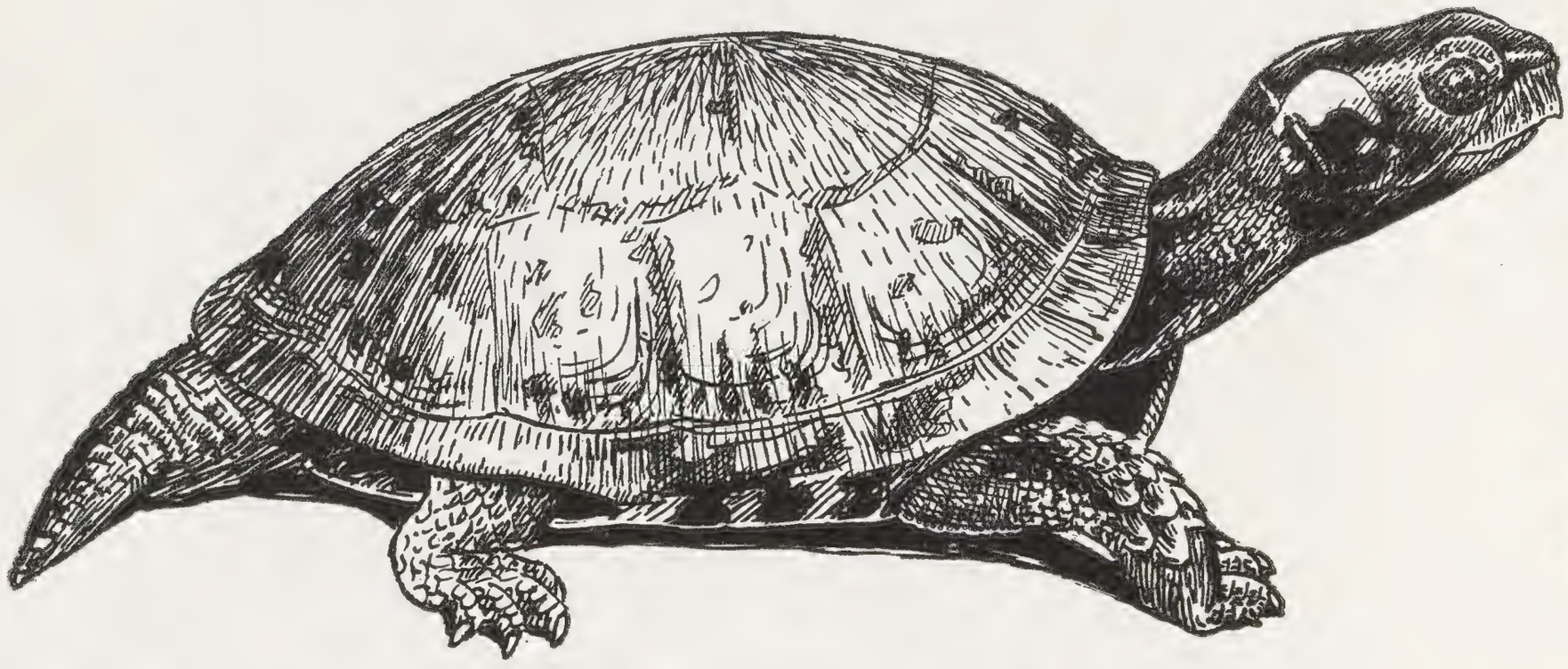
Each year the Zoo's herd of Aoudads produces 6 to 8 young, always appealing subjects. These wild sheep from the desert and adjacent foothills of north Africa have been at the Zoo for many years.

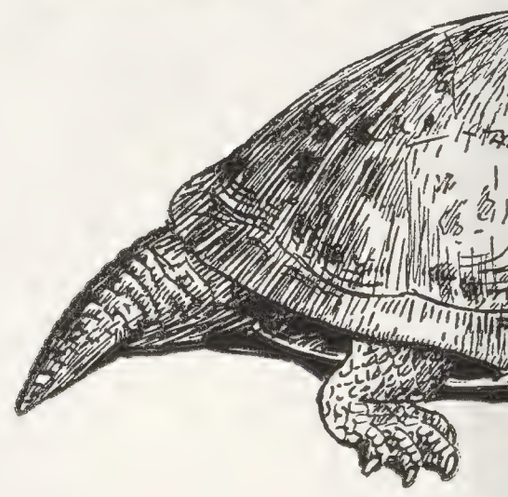
This African White-breasted Cormorant, a resident of the Zoo for nearly 9 years, lives in the large outdoor Flying Cage. It was photographed from the elevated walk which permits unobstructed bird viewing.

The coming of spring means the pelicans will soon be out on Cope Lake, where they make wonderful subjects for zoo photographers, particularly at feeding time. This is a Dalmation Pelican, one of several species that are exhibited in the Zoo.

One of the most popular exhibits with photographers is the White Rhino enclosure, which now includes Cattle Egrets. The rhinos attract flies —a delicacy to insect-eating egrets.

Clemmys muhlenbergi





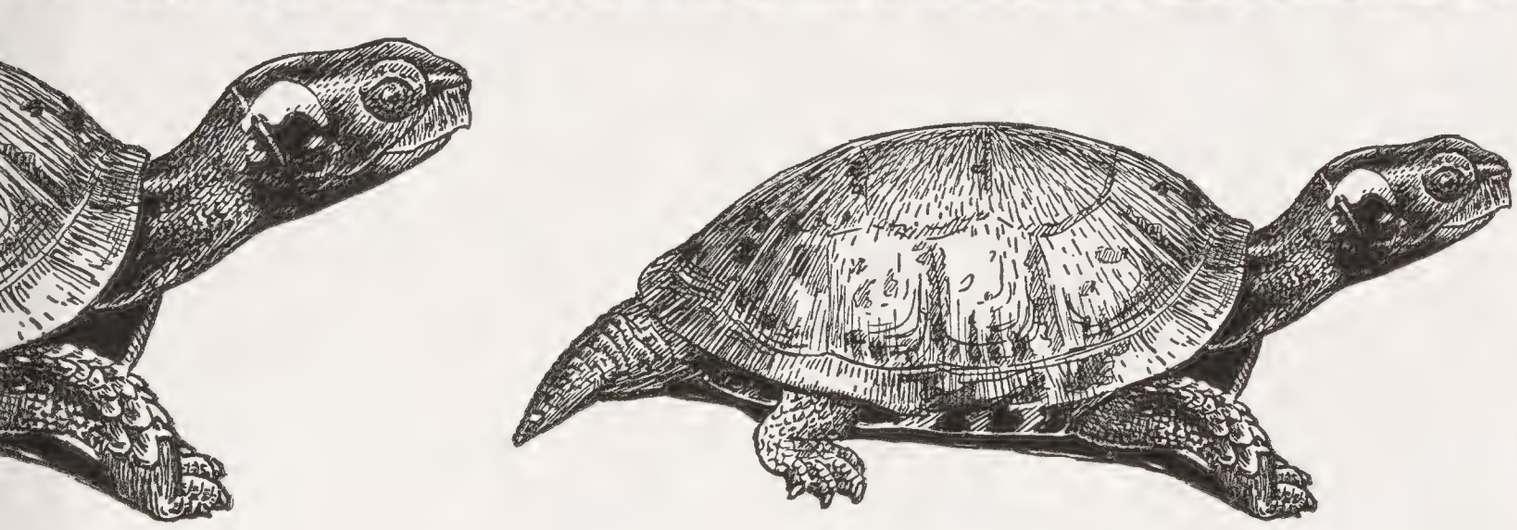
RAREST OF NORTH AMERICA

GETTING SHOT AT OVER a turtle is not the most ideal way of passing a weekend, but Bill Blades does not mind it if the turtle is *Clemmys muhlenbergi,* a small, blackish reptile of the northeastern United States. One recent Sunday afternoon, the mild-mannered Manhattan engineer crouched in the muck of a condemned central New Jersey bog, within shotgun range of its owner, standing on the elevated landfill nearby. Blades' mission: to save at least some of the doomed Bog Turtles before the inevitable "amelioration" of their habitat.

This tableau, which dissolved as Blades crawled away turtleless, tells the tragedy of the Bog Turtle in a nutshell: the swampy areas it inhabits are to a large extent at the mercy of private owners, who sooner or later will convert them into "useful' land or drain them as a mosquito menace.

The Bog Turtle, moreover, has the dubious privilege of being counted among the rarest of North American turtles. This reputation, which the species is stuck with, makes it a most desirable object to the commercial collector and the amateur herpetologist. Many a person would risk being pelted with buckshot in exchange for a Bog Turtle. The going price for this, the smallest member of the New World genus *Clemmys,* is about $25. At a New York pet shop some years ago, I watched a man in conservative attire cheerfully give up a young Rock Python for a three-inch *muhlenbergi.*

What then is so special about this unimpressive reptile, whose maximum shell length does not exceed four and a quarter inches? In appearance, the Bog Turtle has nothing on its generic cousin, the Spotted Turtle, whose black shell is attractively sprinkled with yellow polka dots. The Bog Turtle's upper shell is covered with black or dark brown pigment, broken up in many specimens with light brown lines clustered around the center of each scute. The limbs are dark, occasionally with red markings, and with lighter undersides. The only really colorful mark of this



By ARSENE EGLIS

URTLES

A typical habitat of the Bog Turtle. Bulldozing and draining of such areas, plus collecting, have helped bring it closer to extinction.

animal is a pair of outsized reddish orange or canary yellow blotches, one on each side of the head. These spots, whose probable function is species recognition, are an innocent pale yellow in hatchlings but turn darker with age. Grotesquely large in relation to the whole turtle, they remind one of a mischievous child caught playing with paint. Indeed, captive Bog Turtles, like modern youngsters, are droll, eager, responsive, extroverted and aggressive. These qualities, as well as their small size, make them desirable as pets of apartment dwellers.

But the most important factor in making the Bog Turtle a collector's item is the enigma of its distribution. The species ranges 700 miles in the Atlantic seaboard states, from southwestern Massachusetts to southwestern North Carolina. But within these points the Bog Turtle's distribution is discontinuous, broken up in tiny, isolated colonies, scores of miles or more apart. These gaps are attributed to geological habitat contraction — the natural drying-up of bogs — and to drainage. In relation to the turtle's range, the individual colonies of the species are so few that one must almost marry into a collector's family to induce him to reveal a Bog Turtle locality.

The center of the Bog Turtle settlements is Philadelphia, where the German naturalist Schoepff, serving as a surgeon to a Hessian regiment during the American Revolution, received his first Bog Turtles from the American botanist Muhlenberg of nearby Lancaster. Hence the specific name.

The concentration of Bog Turtle enclaves extends through central New Jersey and continues as a thin tail along the Hudson River in New York State, invading western Connecticut and southwestern Massachusetts. Alexander Agassiz, son of the famous naturalist, took three Bog Turtles from an artificial pond near Newport, Rhode Island, and it is possible that they came from a natural bog in the vicinity. A few relict colonies are found in the Finger Lakes region of New York and in west-

ern Pennsylvania. Isolated colonies occur in Maryland and Virginia, bridging the gap with the populations in western North Carolina.

One baffling aspect of locating Bog Turtles is that a swampy area containing them may be surrounded with apparently identical habitat situations that do not. Evidently, the Bog Turtle places rigid demands on its habitat.

Those bogs that do contain these reptilian aristocrats have a common ecological denominator: water from a permanent source, moving slowly over a mucky bottom or seeping through it. This water movement may be an offshoot of a mountain stream, as in some areas of North Carolina, or it may be seeping spring water — the source of moisture in many New Jersey bogs.

A classical habitat situation in Pennsylvania will consist of sphagnum-lined rivulets, emanating from a shrub-covered area and entering meadowland. Thus irrigated, the meadowland carries pockets of cattails, surrounded by sedge. At the other end of the meadow, the stream water creates a marshy area that is already heavily overgrown by late spring and throughout the summer. Skunk cabbage is almost always in the picture.

The home of the Bog Turtle apparently has to provide two luxuries that rarely go together: a solarium with a cool basement. They take the form of a high tussock of grass and the water-cooled mud below. Bog Turtles, veritable "mudders" at heart, have been observed patrolling these rivulets of muck at temperatures from 60° to 70° F. in search of food — generally all available insect life and carrion, seasoned with *Carex* sedge seed. They climb the tussocks to bask and digest food in the 70° to 80° F. range, or higher. Captive specimens crowd under a hotspot to absorb temperatures as high as 110° F. for short periods. Thus the Bog Turtles seem to require higher temperatures all around than do other northeastern turtles such as the Spotted Turtle and the Painted Turtle.

The Bog Turtle's habitat must, furthermore, provide different water levels for its various growth stages and for the different phases of its activity. Hatchlings, for example, should be looked for among the cattails in the nesting area, where the water is warm and shallow.

Recent studies indicate a seasonal activity cycle for the species. In his talk to a meeting of the Philadelphia Herpetological Society in April, 1965, an event that was a milestone in Bog Turtle research, A. J. Barton disclosed that he had observed a migratory pattern in this species. Barton related how he attached a thread dispenser to the hind marginals of a specimen and thus obtained a record of the turtle's progress, "written" with thread in muck and moss. Bog Turtles apparently begin their yearly two-way cycle in April or May as they head upstream to the feeding and egglaying area, where the water is shallower than in the hibernation area. Barton's observations of one colony indicate that Bog Turtles bestir themselves for the return trip near the end of August. According to a "turtlegram" (written with thread), a migrating Bog Turtle walked 56 feet a day in free movement. The individual did its best walking from 9 a.m. to 1 p.m. The bog under observation required the migrating turtle to cross meadowland. It took the migrant a little less than two weeks to cross the meadow and reach the overwintering area, altogether a trip of 600 to 700 feet.

Such a migratory pattern presumably is present on a smaller scale in other parts of the Bog Turtle's range — in New Jersey and New York, where relict colonies hid in spring-fed "minibogs." A Bog Turtle's urge to migrate apparently is not triggered by a bog that is drying up or is being drained. Instead, the animal will dig in deeper in the hardening mud in search of moisture.

Where drainage is responsible for isolation of colonies, Bog Turtles do not show differences. Variation is discernible, however, in areas where turtle clans have lost contact through long-term natural habitat contraction. Because of the inbreeding in such situations, Bog Turtles tend to vary in their appearance from bog to bog and to resemble one another within the same population.

For unknown reasons, population densities also vary. Barton, who censused representative patches of his study area, found that a 10-acre habitat can harbor as many as 500 Bog Turtles. Yet in other areas, commercial col-

A rare photo of the Bog Turtle in the wild. It is partial to sphagnum bogs, wet meadows and streams and is found on land and in water. It requires higher temperatures than other turtles of the area.

lectors came up with two turtles per acre after digging up and sifting the muck of whole bogs.

It seems that the various "clans" of the species differ in the number of eggs in a clutch. It is widely believed that three eggs are the rule; four eggs would be an exceptional event. Yet the records of Mildred Alexanderson, whose apartment shelters a breeding colony of bog-wrecked *muhlenbergi,* show that only 10 per cent of her clutches contained three eggs, 30 per cent had four, and 60 per cent had five eggs. In 1964, for example, her turtles laid six clutches between June 12 and July 3; of these, four clutches had five eggs each, the remaining two had four each. From these 28 rubbery eggs, 18 baby Bog Turtles hatched between August 3 and August 21 after being kept at 75° F. nights and at 90° F. days. The hatchlings were slightly under one inch long and about three-quarters of an inch wide. Miss Alexanderson observed that the female Bog Turtle does not burrow under moss to lay her eggs, as was previously supposed, but opens and covers a nest in the substrate, as other mother turtles do. Like anybody with a high metabolism, the Bog Turtle shows an immediate and intense appetite after depositing her eggs.

It is probable that, with the advice of experienced breeders, the Bog Turtle could be perpetuated in zoos. Before there is a need for this rear-guard action, however, the conservation of this rarity must begin at its home. And here the crucial problem peculiar to the Bog Turtle – how to stop the housing developments from gobbling up bogs – will be decided in a split second of geological time, the few decades the urban planners need to realize their dream of megalopolis stretching from Boston to Washington and points south. I know of one naturalist who bought a swamp and fenced it in to save a colony of Bog Turtles. But a concerted effort will be needed to insure the survival of this species.

IN THIS ISSUE

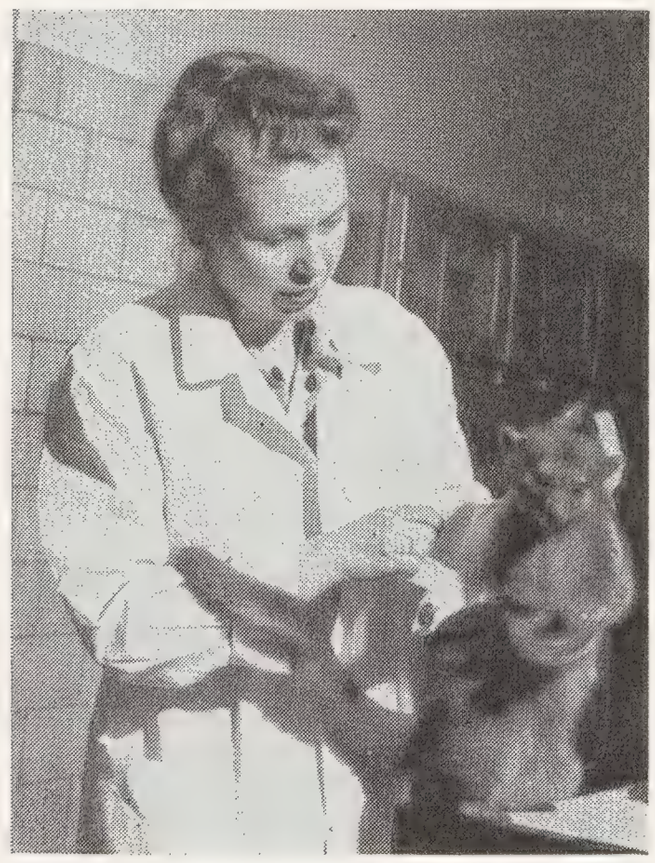
The Cover

Cover photographer **Bill Meng** joined the staff at the Zoological Park last September and has been working almost exclusively since the beginning of the year on illustrations (color and black and white) for a new Bronx Zoo guide book. The latter should be available early in 1968.

Mr. Meng took the cover photograph with a Hasselblad fitted with a 150 mm. lens and lighted his subject with two electronic flash units.

Baboons

Author Patricia O'Connor has been the veterinarian at the Staten Island Zoo since 1942, three years after her graduation from the College of Veterinary Medicine at Cornell University.



Duo at the Staten Island Zoo's animal hospital: Veterinarian O'Connor and one of her patients, this one a friendly Kinkajou.

Dr. O'Connor is a Fellow of the New York Academy of Sciences, chairman of the Zoo Veterinarians' Association, and the author of a new book, *Bibliography of References to Diseases of Wild Mammals and Birds,* the result of a 10-year study that produced more than 8,000 references.

She is the mother of three sons and the widow of Dr. John Lewis Halloran, also a veterinarian.

Thornbirds

Author **Alexander Skutch,** a distinguished ornithologist, is a regular contributor to *Animal Kingdom,* writing on the avian riches of South and Central America.

Lloyd Sandford's first connection with the Zoo was in 1941 as a free-lance artist to make bird drawings for species labels. Later the same year he joined the armed forces, but he returned in 1946 as a full-time employee and has drawn and painted many thousands of illustrations for animal labels in the years since.

Mr. Sandford studied at the National Academy of Design, the Newark School of Fine and Industrial Art, and the Art Students League. He has illustrated a number of books over the years, the most recent being *Reptiles and Amphibians of North America* by James Oliver, *Birds of New Caledonia* by Jean Delacour and the soon-to-be-published *Black Jack — Last of the Big Alligators* by Robert McClung.

Focusing

In addition to his sizable contribution to this issue of the magazine, Zoological Society member **Paul Kovac** took the cover photograph of the Indian Peacock in display that appeared on the cover of the February issue.

Bog-Turtle

Paris-born **Arsene Eglis** is a journalist who has contributed free-lance material on turtles to a number of publications, including *Animal Kingdom* ("The Pancake Tortoise" July-August, 1964). He was educated in Germany and the United States, holding an M.A. degree in American Literature from New York University.

Mr. Eglis has worked on the rewrite desk at the International News Service, as an associate science editor for Funk & Wagnalls Encyclopedia, and presently as press officer for Radio Liberty.

BEHIND THE SCENES

Letter-to-the-Editor

Dear Editor:

Last January while in the Amboseli Reserve in Kenya my wife and I saw a performance by a lion which we thought extraordinary. Although I have read much about African game I have never heard of anything of the kind before and so I think a brief report might be of some interest.

From a Landrover we watched a young male lion approximately four years old (his mane was still quite short) bound out of some brush, fling himself on the neck and shoulders of a large, plump zebra and knock the zebra down. Both animals fell into a small brook with a big splash. The lion sprang up quickly, seized the zebra's neck behind its ears and then forced the zebra's head under water. For three or four minutes the lion held the zebra's head under water until it drowned. Then with great effort the lion dragged the body up a short bank and for some 40 feet along the top of the bank until it found a place suitable for its meal. All this time we were within 35 to 40 feet taking pictures.

I would be fascinated to know if zoologists and naturalists have any other records of lions killing by drowning. Was this performance unique? Was this a particularly smart lion?

Orville Prescott
New Canaan
Connecticut

The chairman of the mammal department is doubtful that the lion intentionally drowned the zebra. It is possible that the zebra drowned by coincidence in the process of being killed by the lion. Ed.

Future Exhibits

The coming of spring brought a resumption of work on the Zoo's future exhibit for American Bison, a three-acre "range" being fashioned by filling in Lake Agassiz at the northern edge of the Park and restoring the Bronx River to its former channel. Hidden moats will help provide the range with a naturalistic look.

Late in April work commenced on new habitat exhibits for Polar and Kadiak Bears, to be located at the site of the former bear dens.

The Polar Bears will be presented to the public in an exhibit that will utilize the natural rock formation in the area, increase the available water area, add simulated snow and ice, provide unobstructed viewing through moating, and add adequate dens and breeding enclosures.

A major feature of the Kadiak exhibit will be Herculite glass panels which will give the visitor the exciting experience of standing within inches of these huge brown bears.

Mikumi National Park

The Frankfort Zoological Society recently contributed funds for the construction of a youth hostel in Tanzania's Mikumi National Park. The hostel, which will be the fourth donated by the Frankfort organization to various national parks and preserves in East Africa, is for the purpose of encouraging the young people of Tanzania "to visit Mikumi National Park and to become acquainted with the wonderful wild animals of their country."

Consultant in Pathology

Dr. John M. Budinger, head of the pathology department at Lawrence Hospital in Bronxville, New York, was recently appointed to the post of Consultant in Pathology at the Zoological Park. Dr. Budinger has worked closely with Zoo Veterinarian Dr. Charles Gandal for a number of years.

San Diego to Cincinnati

The future presence of the Flat-headed Cat (*Felis planiceps*) in its Southeast Asian habitat is very uncertain. This was the message of Dr. Boonsong Lekagul of Bangkok, Thailand, at a recent conservation conference in San Diego. He also mentioned the Bali Tiger, the Clouded Leopard and the Marbled Cat as being in trouble in their Asian habitats. Dr. Lekagul urged representatives of various zoological parks in attendance to try and raise these species in captivity.

Not long afterward, the San Diego Zoo sent its solitary female Flat-headed Cat to the Cincinnati Zoo, which has two males and an outstanding record in the captive breeding of wild cat species.

ILLUSTRATION CREDITS

Cover — William R. Meng; pp. 34-35 — Irven DeVore; pp. 36-41 — N.Y.Z.S. photos; p. 42 — Sherwood L. Washburn; p. 43 — Irven DeVore; pp. 44, 48-51 — Lloyd Sandford; pp. 52-57 — Paul K. Kovac; pp. 59-61 — Arsene Eglis.

Publications of Interest

THE DEER AND THE TIGER. By George B. Schaller. 370 pp., 30 photographs in black-and-white, 17 figures, 58 tables. The University of Chicago Press, 1967. $10.00.

Few animals are better known, at least by name and sinister reputation, than the tiger but few are actually less well understood. Not that there is a lack of reports, for the literature of the subject is extensive. But these accounts are largely devoted to stories of the tiger as an object of the hunt, of the depredations of the occasional man-eater and the toll of prey animals, including domestic livestock. George Schaller, well known for his detailed studies of the Mountain Gorilla in Africa, devoted 14 months to intensive observation of the behavior and ecology of the tiger in the Kanha National Park in Madhya Pradesh, north-central India. In this book, he presents the first unbiased picture of the tiger in its natural ecological position.

To do this, of course, there must be studies of climate, vegetation and the animal life involved. Dr. Schaller has established the first two of these by means of numerous tables and maps. Since the tiger is the central figure in this instance, its prey animals are most important and excellent behavioral and numerical accounts are given of the dwindling herds of Chital or Axis, Barasingha and Sambar Deer, Blackbuck and Gaur. Various lesser predators are mentioned rather briefly, including the Leopard, the Sloth Bear, the Striped Hyena and the Wild Dog or Dhole.

Much of Dr. Schaller's observation took place from a jeep or from the back of an elephant, both devices being less disturbing to a tiger than a man on foot would be. Many nights were spent in watching posts near kills.

The net result of these studies reveals the male tiger as far less solitary in habit than has been supposed, with greater tolerance for females and their cubs living in the same territory.

This is basically a technical book of great value to workers in the fields of ecology, behavior and conservation. If the general reader is not too much disturbed by the frequent tables, maps and figures scattered through the text, he will find in it a revealing picture of the much maligned tiger. Lee S. Crandall

THE ALIAN ANIMALS. By George Laycock. 22 illustrations in black and white, from photographs. 240 pp. Published for the American Museum of Natural History by the Natural History Press, Garden City, N. Y. $4.95.

An account of the introduction of various mammals, birds, fishes and invertebrates into new habitats in many parts of the world, usually with disastrous or negative results. Well-intentioned but not fully considered projects brought the House Sparrow and the Starling to America, the European Rabbit to Australia and New Zealand and the mongoose to the West Indies and Hawaii. All these and many more, including the fantastic importations into New Zealand, are recounted in detail in this useful book, leading up to a sensible plea for better controls and proper scientific investigation of possible results, before liberation of further "aliens" is undertaken L. S. C.

AUF SAFARI IN EUROPA. By Lothar Dittrich. 168 illus. in black and white, 3 in color, all from photographs. 360 pp. Fackeltrager-Verlag, Schmidt-Kuster GmbH, Hanover, Germany, 1966. (No price).

In this handsome volume, Dr. Dittrich, who is Scientific Director of the Zoological Gardens of Hanover, gives brief but interesting histories of the zoological gardens of Europe. Since the text is in German, it will be helpful only to those sufficiently proficient in that language. Those who are not will find ample solace in the magnificent, full-page illustrations, many representing great animal rarities. In most cases, identities will be discernable even by the non-proficient. L. S. C.

THE MIGHTY BEARS. By Robert McClung. Illustrated by many photographs in black and white. 83 pp. Random House, New York, 1967. $1.95.

The latest of the long series of books about animals written by our former Curator of Mammals and Birds, primarily for children. This small volume is devoted principally to the bears of North America but manages to include all of the known species and the Giant Panda as well. A great deal of sound, factual material is given in simple narrative style. The photographs are adequate but the author's excellent drawings, used to illustrate preceding books, will be missed. L. S. C.

Summer Courses for Young People at the Bronx Zoo

GRADES 3 & 4

Introducing the Reptiles

Animals of the New York Area

Animal Homes

How Animals Move

GRADES 5 & 6

Aquatic Animals

Predators and Their Prey

Arboreal Animals

Modifications and Special Adaptations of Hair

GRADES 7-9

Aspects of Ecology

JULY 10-AUGUST 31

FOR INFORMATION — Write to the New York Zoological Society's Education Department. New York Zoological Park, 185th Street & Southern Blvd., Bronx, New York 10460.

NEW YORK ZOOLOGICAL SOCIETY

590.673
A59

animal kingdom

JUL 18 1967

VOL. LXX, NO. 3, JUNE, 1967

animal

MAGAZINE OF THE NEW YORK ZOOLOGICAL SOCIET

CONTENTS

Malagasy Lemurs — Clues to Our Past, 66
By Alison Jolly

Animal Kingdom Reports, 76

Would You Believe — The Kiwi? 78
By Dal Stivens

Olms — Of Such Are Legends Made, 84
By Brother G. Nicholas, F.S.C.

Pride's Progress, 88
Review by John Miller

Mixing It Up in Brookfield's Reptile House, 90
By Raymond L. Pawley

The Bookshelf, 96

About the Authors, 96

Illustration Credits, 96

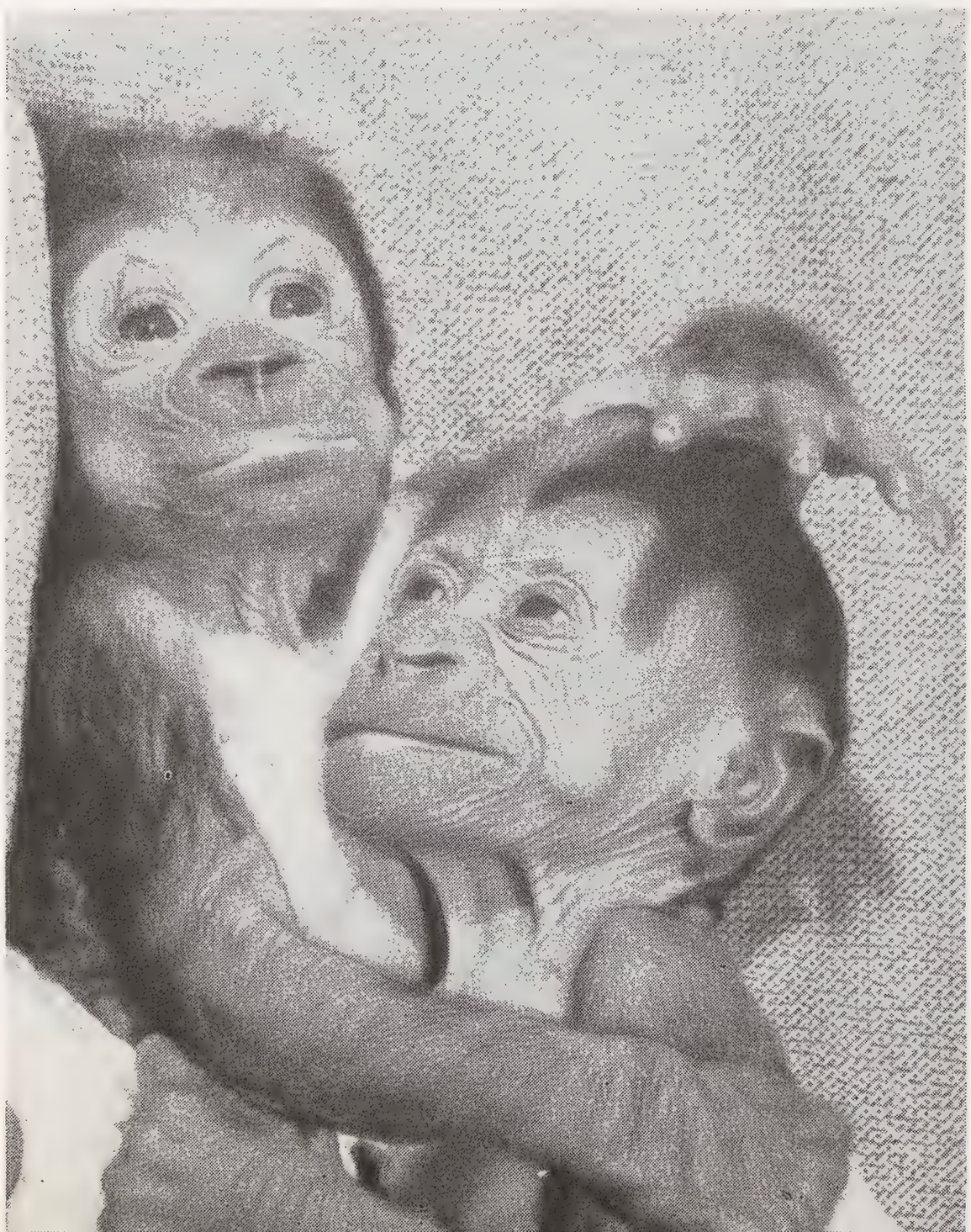
Issued bi-monthly by the New York Zoological Society at the Zoological Park, Bronx, N. Y. 10460. Editorial and Subscription Offices at the same address. Title registered with the U. S. Patent Office. Subscription, $3.50 a year; single copy, 60 cents. Same rates for all foreign countries and Canada. Second-class postage paid at Bronx, N. Y. Send Form 3579 to Bronx, N. Y. 10460.

kingdom

VOL. LXX · NO. 3 · JUNE, 1967

ABOUT THE COVER

A bit young for "cover girls," perhaps, but nevertheless quite fetching, the playful pair pictured on the cover of this issue was born to the Frankfurt Zoo's female gorilla, "Makula," on May 7. The twins, both female, have been the center of world-wide attention since they arrived on the Frankfurt scene. The photographs of the gorilla sisters were supplied to Animal Kingdom by the Frankfurt Zoo. For more on these winsome gorilla babies, see page 76 of "Animal Kingdom Reports," a feature offered for the first time in this issue. It is hoped that "Animal Kingdom Reports" will be a regular feature of the magazine, bringing you in subsequent issues news of interest to all who are interested in animals, zoos, aquariums, and conservation. This new service will present news of the animal world, in capsule form, to our readers. Comment on "Animal Kingdom Reports" will be appreciated.



NEW YORK ZOOLOGICAL SOCIETY
630 Fifth Avenue, New York, N. Y. 10020

President
Fairfield Osborn

First Vice-President;
Chairman, Executive Committee
Laurance S. Rockefeller

Vice-President
Henry Clay Frick, II
Robert G. Goelet

Secretary
John Elliott
Harold C. Palmer, *Assistant Secretary*

Treasurer
David Hunter McAlpin

Assistant Treasurer
Eben W. Pyne

BOARD OF TRUSTEES
(*Executive Committee**)
Alexander Aldrich, George F. Baker, Jr.*, Robert E. Blum, William R. Coe, C. Suydam Cutting, John Elliott*, Charles W. Engelhard, Henry Clay Frick, II*, Robert I. Gannon, Peter R. Gimbel*, Robert G. Goelet*, Peter Grimm, John N. Irwin, II*, Warren Kinney, Anthony D. Marshall, Otto Marx, Jr., David Hunter McAlpin*, Peter Matthiessen, G. W. Merck, Charles W. Nichols, Jr., Fairfield Osborn*, Augustus G. Paine, II, Howard Phipps, Jr., John H. Phipps, John Pierrepont*, Eben W. Pyne, Laurance S. Rockefeller*, David T. Schiff, John M. Schiff, Henry Sears, Chauncey Stillman, Joseph A. Thomas, Landon K. Thorne, Jr., Alfred G. Vanderbilt, Robert Winthrop.

Ex-Officio:
The Mayor of the City of New York, Hon. John V. Lindsay
Administrator of Recreation and Cultural Affairs, August Heckscher

General Director
William G. Conway
John Tee-Van, *Emeritus*

ZOOLOGICAL PARK
William G. Conway, *Director & Curator of Birds;* Charles P. Gandal, *Veterinarian;* Hugh B. House, *Assistant Curator & Chairman, Mammals;* Grace Davall, *Assistant Curator, Mammals & Birds;* Joseph Bell, *Associate Curator, Birds;* Herbert J. Knobloch, *Curator, Education;* Charles B. Driscoll, *Superintendent, Operations;* Edward Kearney, *Manager, Facilities Dept.;* Lee S. Crandall, *Zoological Park Consultant & General Curator Emeritus;* Roland Lindemann, *Consultant, Mammal Management;* John M. Budinger, *Consultant, Pathology.*

AQUARIUM
Ross F. Nigrelli, *Director;* Robert A. Morris, *Associate Curator;* Lars Mellkvist, *Assistant Superintendent;* Jewell Bungay, *Business Manager;* Louis Mowbray, *Research Associate, Field Biology;* Christopher W. Coates, *Director Emeritus.*

OSBORN LABORATORIES OF MARINE SCIENCES
Ross F. Nigrelli, *Director;* Martin F. Stempien, Jr., *Assistant to the Director;* William Antopol, Jack T. Cecil, Harry A. Charipper, Kenneth Gold, Myron Jacobs, Klaus Kallman, Vincent Liguori, John J. A. McLaughlin, George D. Ruggieri, S.J., Martin P. Schreibman.

INSTITUTE FOR RESEARCH IN ANIMAL BEHAVIOR
(Operated jointly by the Society & Rockefeller University)
Donald R. Griffin, *Director;* Peter R. Marler, Jocelyn Crane, Roger S. Payne, Richard L. Penney, Fernando Nottebohm, George Schaller, Thomas T. Struhsaker, C. Alan Lill, O. Marcus Buchanon, *Resident Director, William Beebe Tropical Research Station.*

GENERAL
Walter Lerchenfeld, *Comptroller;* John McKew, *Personnel Manager & Assistant to the Director, Zoological Park;* Gordon Cuyler, *Membership Chairman & Administrative Associate;* Jerry M. Johnson, *Curator, Department of Exhibition and Graphic Arts;* Edward R. Ricciuti, *Editor & Associate Curator, Publications;* Dorothy Reville, *Assistant Editor;* Sam Dunton, *Photographer.*

AFFILIATE
Jackson Hole Biological Research Station
L. Floyd Clarke, *Director.*

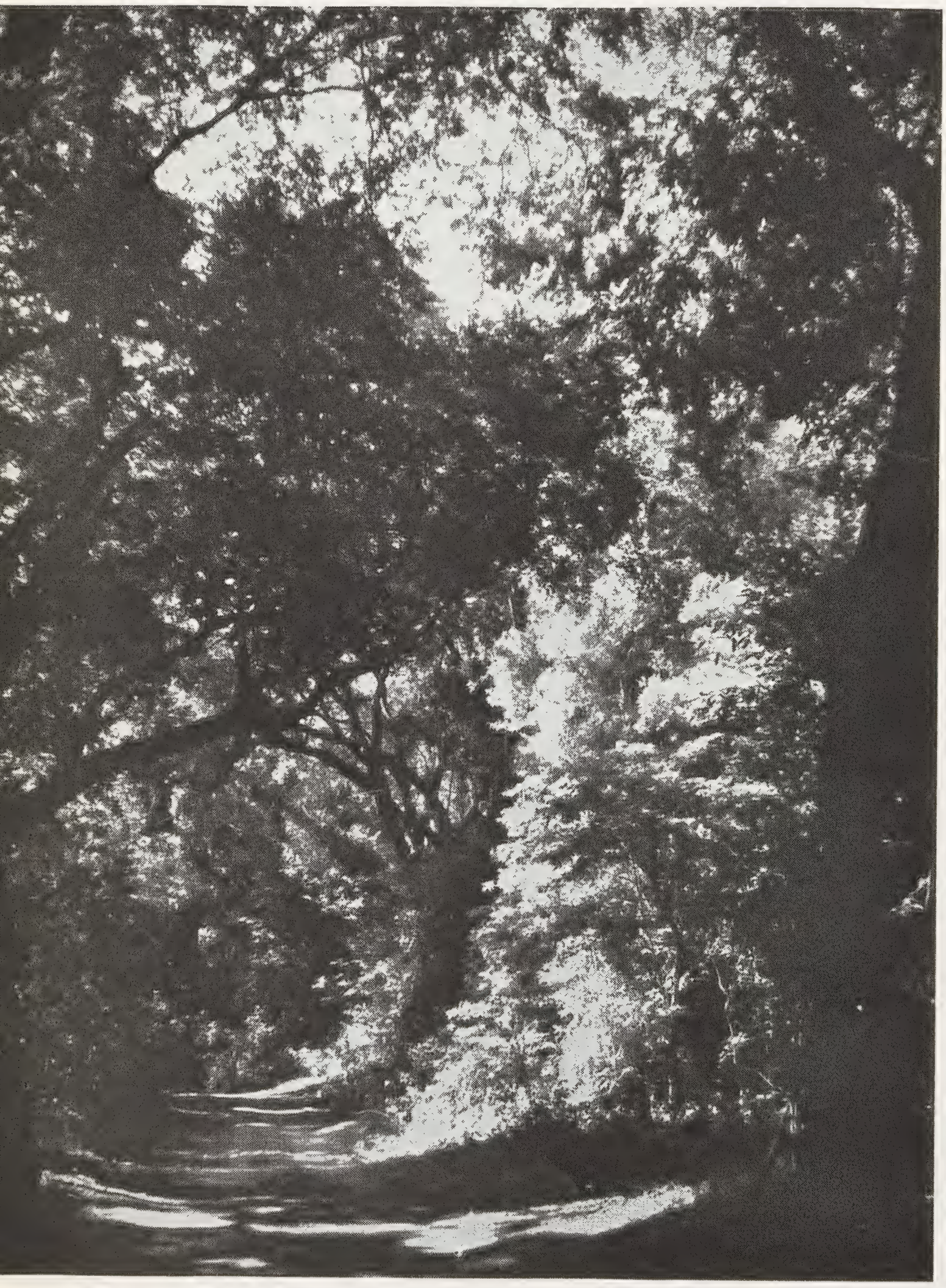
SMITHSONIAN INSTITUTION JUL 14 1967

By ALISON JOLLY

The material in this article was obtained by the author while studying Lemurs in Madagascar under the sponsorship of the New York Zoological Society.

Many of the illustrations in this article were published in Alison Jolly's book, LEMUR BEHAVIOR: *A Madagascar Field Study. A review of this book appears on page 96.*

MALAGASY LEMURS-CLUES



O OUR PAST

"Bunthorne" and "Young Tyrone" were stink-fighting. Bunthorne rocked back on his haunches, gripped the branch with his opposable great toes, and drew his black-and-white ringed tail between the spurs on his forearms. Then he stood and arched it over his back, shaking his scent forward at Young Tyrone — not lashing, but quivering the tail like an outraged feather duster.

Bunthorne sat down and yawned elaborately. Tyrone seized a vertical twig in both palms, and flung his shoulders from side to side, wiping his hands round the branch as it shook back and forth. He leaped backward a discreet six feet. Bunthorne, who was winning, sprang forward, but not too far, though he could have closed the 20-foot gap between them in one bound. Instead he grabbed Tyrone's twig, sniffed, and marked it with his own palms, flailing the tuft of leaves at the end to signal an island of formalized fury in the vast green dome of the tamarind tree.

The stink-fight lasted 50 minutes and gave me a crick in the neck. I sat under the tamarind, at the south end of Madagascar, laughing at the little lemur warriors and recording their tournament. Bunthorne and Young Tyrone belonged to "my" troop of Ringtail Lemurs, so I knew them well as subordinate males who ordinarily lagged behind the troop and groomed each other for want of better company. Now as the mating season approached, they challenged each other; later, when females came into heat, Bunthorne fought the leading male in earnest, with long slashes of his canines. This was the sort of thing I had come to learn: the local gossip of lemur troops, their gestures, composition, dominance structure, mating, and how they brought up their young.

But why lemurs? And why in such detail? Because lemurs, isolated on Madagascar for 50 million years, resemble in many ways man's earliest ancestors. They are prosimians, whose

Along forest paths like this (far left) near Madagascar's Mandrary River, the author studied lemurs. She watched displays of behavior such as troop progression of Ringtail Lemur females, shown at left.

Ringtail Lemurs are equally at home high in the treetop
or on the floor of Madagascar's leaf-roofed forests. The
large-eyed primates frolic in troops through the gallery
woods. Lemur on ground (right) munches on a tamarind pod

lineage branched off from ours before even the true monkeys were evolved. Lemurs have large, forward-looking eyes and hands with fingernails and thumbs set in opposition to the fingers. They lack, though, the monkey's round skull and endless capacity for household destruction. By any of the psychologists' tests — pulling strings, opening boxes, learning to choose a red square over a blue triangle — lemurs are slower than almost any monkey. And yet they have evolved societies like those of monkeys: permanent troops, with complex relations between the individuals.

Primatologists are peering at ape and monkey troops all over the tropics, trying to piece together some possible origins of human behavior. The lemurs, in turn, provide clues to the origins of monkey behavior. What sort of social life is possible to an anatomically primitive, intellectually undeveloped primate? If, in fact, the lemurs behave at all like true monkeys, by looking at the common elements we can make guesses about the behavior of our own distant ancestors.

This is why lemurs are interesting, but their peculiarities are what make them fun. Like many other island groups, they have radiated into a fantastic diversity of creatures: three families, 20-odd living species, perhaps 40 subspecies. They range from the nocturnal Mouse Lemur, world's smallest primate, to the harlequin Indri (*Indri indri*), black and white and large as a three-year-old child, which sings in chorus from hill to hill. Since lemurs, like other primates, are visual animals, many races recognize each other by gaudy colors and patterns: white clown eyebrows, orange beards, or black males paired with golden females, each with a great sunburst of whiskers round its head.

Fortunately, the French zoologists Jean-Jacques and Arlette Petter had already spent 18 months surveying lemur behavior. From their work it was clear that some lemur genera are solitary, some form small groups of about five individuals, while a few form troops of 20. The Petters have returned to Madagascar several times since their original study, trying to save from extinction the weird Aye-aye, a lemur with bat ears that detect insects inside trees, beaver teeth that strip the bark, and an elongated third finger with a hooked claw for extracting fat larvae from their holes.

To complement the Petters' work, I wanted to study intensively a few troops in one place, where I could know many individuals, rather than many species. The first problem, though, was to find the right place. Madagascar is 999 miles long, more like a continent than an island. Although the central plateau is burned

and bare, the unique indigenous woods survive around the periphery.

I went eastward, first, to the mountain jungle. A spine of highlands runs down Madagascar's eastern side, catching the prevailing winds and clothed in tangled rain forest with rosewood, sandalwood, tree ferns and orchids — this is the romantic forest one imagines from the word Madagascar, filled with the drip of water from leaves and the cascade of waterfalls. Between the vertical tree trunks leap diademed Sifaka (*Propithecus diadema*), with charcoal gray backs and orange arms and legs. A troop of Gentle Lemur (*Hapalemur griseus*) bounds past, small gray chatterers, sassy as squirrels. And then the Indris begin to sing, three members of a group starting not quite a third apart, so that you yearn for a piano tuner. Their wails rise and fall together, while other groups answer a half mile away. The Indris converge upon you, tailless, piebald black and white, with dog-like muzzles but the intent forward stare of a primate. Then, as they lift their heads to roar alarm, their lips push out to show little red mouths, like flapper makeup of the 1920s.

But detailed observation would be difficult

indeed in the solidly braided jungle, so I turned next to the western woodlands. The mountain range which takes the rain leaves western Madagascar dry, with open scrub woods, and an entirely different range of mammals, birds and insects from the eastern forest. Here were no Indri, but Coquerel's Sifaka (*P. verreauxi coquereli*), maroon eagle-wing patterns on their white arms and legs. Mongoz Lemurs (*L. mongoz*), with red beards and white noses, crossed the branchy paths of Brown Lemurs with black heads (*L. fulvus fulvus*). But here, too many lemurs ended in a Malagasy stew for me to stay – it would have been ill-advised for them to trust humans too far.

On I went, to the north coast, with its coconut palms and real Jules Verne giant clams, then south to the lunar vegetation of the spiny desert. At last I found the ideal site, a gallery forest along the Mandrary River, in the extreme south of Madagascar, where massive tamarind trees, hung over with lianas, grew from the rich alluvial clay. This gallery woods was protected, and the lemurs knew long since that they had little to fear, even from me with my black-eyed lenses.

Thus I settled down to work on two species, the Ringtail Lemur, *Lemur catta*, and *Propithecus verreauxi verreauxi*, the true White Sifaka. The first day after deciding to settle by the Mandrary, I walked into the woods. I suddenly saw staring lemon eyes, a black, heart-shaped face, and a square white-furred head. The Sifaka clung vertically to a vertical trunk, its slim tail curled up like a watchspring below. Then, without warning, it leaped. The animal seemed to double in size. Its great hind

Ringside view of Ringtail Lemurs at home—Animals shown above bask in sun. Individual at far left scratches with the toilet claw. Male lemur (below) voices a howl, while another male Ringtail, ears back, wrist-marks its tail.

Body coloration of normal White Sifaka Lemur (left) contrasts markedly with darker color of melanotic individual of the same species (right). Sifakas, the author found, may break into a chorus of sounds resembling loud snores.

legs, longer than head and body, propelled it backward into space. The white body gleamed against blue sky, soaring as much as 30 feet in a curve taut as ballet. And it had not jumped away, but toward me. The *Propithecus* turned in mid-air, to land with both hind feet first, like a jumping man. The legs folded, and again it clung vertically to a trunk, still watching me. Another followed across the same gap, and another, until the five troupe members converged to a half circle less than 15 feet away.

One then began to growl with a sound remarkably like a snore. It opened its mouth and remarked, *shifakh! Shifakh*, it said again, only louder, the first syllable bubbling in its throat, the second closing with a click like an amplified hiccup. Soon all five were mobbing me as birds mob a cat, and less than one spring away. At this point, say the local Malagasy, the Sifaka fall on you and eat you, a wild misjudgment of these placid vegetarians. In fact, when the group chorus of snores and growls did not dislodge me, after half an hour of trying, the *Propithecus* turned to go.

But now their way was blocked; a troop of Ringtail Lemurs had approached from behind. At first I could only see some 20 striped tails, dangling from the branches like so many huge, fuzzy caterpillars. Soon, though, my eye found the arched gray backs in the dappled light, and the sharp, raccoon-like face masks. Some then began a game of jump-on-and-wrestle: one leaped to a springy branch, then another landed on the first. The advantage lay with the one on top, who could tug with hands and feet, while the one beneath had to spare a grip to keep them both on the branch. As the *Propithecus* tried to pass, the Ringtails turned to teasing them. One *Propithecus* landed on the play-branch, but a male Ringtail leaned forward and cuffed the air in front of his larger cousin. The *Pro-*

pithecus promptly swung under the branch and dropped. A second *Propithecus* leaped to the branch's far end, then on the upswing leaped again directly in front of the *catta*. The Ringtail mock-lunged with head and shoulders, but the Sifaka, in high alarm now between me and the Ringtails, lifted its head and roared.

The roar, or bark, or bellow, filled the woods with its echoes. At once, all the *Propithecus* roared in synchrony with the first. The *Lemur catta* fled lower in the trees, for *Propithecus* usually roar only to the real menace of low-flying hawks. My first known troop of Sifakas leaped away, while the cocky Ringtails came out from under cover and reoccupied their playground.

It was just over a year later that I watched Bunthorne and Young Tyrone at their stink-fight. By that time conclusions began to emerge from the list of observations. My original questions, "how much do social lemur troops resemble those of monkeys?" and "does the form of lemurs' social life reflect their lack of intelligence?" had partial answers.

In many ways the lemurs did resemble monkeys. Their troops, even the small *Propithecus* groups, had several males as well as females. An infant of either sex might remain for life

Brown Lemurs often associate with Ringtails. Brown Lemur (above) sits close by Ringtail family, while Ringtail female (below) cuffs a Brown. Lemur behavior may hold clues to development of human society.

in the troop of its birth, not leaving to join a band of adolescent bachelors. This troop composition is common among primates found in over half the genera studied, in New World as well as Old World forms. Among other mammals, such a social structure is extremely rare: the male beaver or seal or gnu must leave its group by adolescence.

Another similarity between lemurs and higher primates is the importance of contact, grooming and play. These "friendly" gestures take place among all social mammals, but their role in primate society seems fundamental, as the social cement of the group. Monkeys groom by picking through the fur with their fingers or lips, while lemurs scrape each other with their lower canines and incisors, the so-called toothcomb. For years the toothcomb puzzled scientists: was there, perhaps, some frightful ectoparasite which could only be removed by sacrificing all the lower front teeth to make such a scraper? At last it became clear that there must be considerable selective advantage to a "well-grooming" lemur in the social group, for lemurs, like monkeys, groom each other in greeting, pacification, mother-infant relations, sexual advances, when waking up and when going to sleep.

One of the theories which gave most impetus to the study of primate behavior held

that society developed from the males' year-round attraction to females. It now seems, however, that many or most monkeys breed seasonally. The lemurs add a further objection to the original theory — they have presumably always had seasonal breeding, and the Ringtails may have one of the shortest mating season in mammals.

A female Ringtail Lemur is apparently receptive for less than 24 hours a year, if she conceives successfully. In my forest, the few troops I knew mated over a period of only two weeks. They worked up to this season through a month of ever more frequent spats, scent-marking, stink-fights and jump-fights, as well as more friendly approaches and grooming. At last, when the females came into oestrus, the males fought over each one, in defiance of the previous dominance order. Bunthorne turned out more like Don Juan. But after the brief orgy passed, lethargic calm settled over the troop. The males nursed their gashed limbs and flanks and relapsed into their previous hierarchy. Even Bunthorne and Young Tyrone again lagged behind and groomed each other.

In summary, I found that at least some lemurs form typical primate multi-male troops, where an infant of either sex may remain for life in the troop of its birth. As in monkeys, the lemurs maintain strong cohesive bonds of contact, grooming and play. In some respects, of course, they differ, their sexual synchrony and many aspects of dominance relations lying at one extreme of the wide primate spectrum. However, it is fair to say that, though lacking higher primate general intelligence, the lemurs have evolved a truly primate society.

This leads me to speculate further: perhaps our own ancestors passed through such a stage. Monkey-like cleverness only appears in the context of monkey societies, while the lemurs have society without cleverness. Furthermore, a monkey learns almost all its behavior toward objects by social example. If this argument is right, in our own line, too, social bonds may have preceded and favored the evolution of manipulative cleverness, and man's social emotions are older than all his general ingenuity.

The lemurs hold many more surprises for us, surely, more to learn and more to enjoy. But they, like so much of the world's wildlife, are threatened. One cannot blame the hunter who eats his rice with occasional lemur stew. But habitat destruction in Madagascar is irrevocable. The Malagasy forests, once burned, never grow back. The soil leaches away, and though alien teak or eucalyptus can take root, year by year the native flora retreats.

Already, most of Madagascar is bare plateau, clothed in bunch grass, bleeding red earth through its eroding gullies into the sea. The lemurs survive in forests round the periphery, with the remaining Malagasy carnivores, insectivores, birds, butterflies. Many species seem in little danger now — Ringtails, for instance, will swagger on for many years. But all become rarer, and, with present trends will reach a point one by one past saving. Madagascar is uniquely rich, a record of the dawn of the age of mammals, but it is difficult to hope that the lemurs, so full of clues to our own past, have themselves much future.

ANIMAL KINGDOM REPORTS . . .

NEWS OF ZOOS, AQUARIUMS AND CONSERVATION

TWIN GORILLAS BORN AT FRANKFURT

"MAKULA," Frankfurt Zoological Gardens' female Lowland Gorilla, has given birth to twins.

The young gorillas, females, were born May 3 to the 11-year-old "Makula." Both youngsters were taken to the home of Head Keeper Horst Close.

Birth weights of the infant gorillas were 1700 grams and 1900 grams. "Makula's" first offspring, "Max" weighed in at 2100 grams when he was born in 1965.

"Makula" was obtained by the Frankfurt Zoo in June 1956. This is the third time "Makula" has given birth.

The father of the newly-arrived twins was "Abraham," who died last January after a heart attack. He has been replaced by a new male from the Oklahoma City Zoo.

SPECIAL DELIVERY

TRAPPED BY A POACHER'S SNARE, the female Spotted Hyena was badly injured when rangers found her in the vicinity of South Africa's Kruger National Park. The animal had to be destroyed — but she was carrying young. A quick Caesarean section was performed, and three young hyenas — open-eyed and able to walk — were delivered.

Unfortunately, one of the young died but

the others, a male and a female, remained healthy. Now nearing a half-year in age, the hyena pups are on exhibit at the puma house of the National Zoological Park, Washington, D. C.

The Washington zoo received the pups April 6 from the National Zoological Gardens of Pretoria, South Africa.

"1 HEAD, LIVE MONKEY"

"DENNIS," young male Orang-Utan confiscated by United States government authorities at Dulles International Airport February 25, is doing well in Washington's National Zoological Park.

The orang-utan is being housed at the zoo pending its disposition by a United States District Court in Alexandria, Va.

The young ape, suffering from exposure and malnutrition, was rescued from a flimsy shipping cage, labeled "1 head, live monkey," after arrival at the airport outside the nation's capitol.

The shipment of the orang-utan, an endangered species, was intercepted by United States Customs Inspectors and Game Management agents.

A joint statement by the Treasury Department's Bureau of Customs and the Interior Department's Bureau of Sport Fisheries and Wildlife alleged that the shipment violated a federal law prohibiting importation of wild mammals and birds, and interstate commerce in such wild animals that are not taken by legal methods. Both Indonesia and Malaysia have laws protecting wild orang-utans. Federal regulations also specify that animals taken by legal methods be identified on the shipping carton.

Game management agents had received a tip that the orang-utan shipment was coming through London from Bangkok, Thailand, via a large airline, and Customs inspectors throughout the country were notified.

The orang-utan is found in the wild only on the islands of Borneo and Sumatra. Harry A. Goodwin, Staff Specialist for Endangered Species in the Bureau of Sport Fisheries and Wildlife, said there is apparently a large illicit international trade in young orang-utans which were captured after killing the highly protective parents.

To help control the illegal trade, members of the American Association of Zoological Parks and Aquariums have worked hard to stop the importation of orangs through illicit channels. The organization maintains a record of all orang-utans in captivity throughout the world to aid in controlling the illegal trade.

The brutal aspect of the trade is that infant orang-utans are usually captured by killing the adults. Counting those that die because of poor handling, one smuggled animal may mean several dead ones. Zoos of the United States and Canada are attempting to establish a major captive breeding program. Many animal dealers have also cooperated in the effort.

"BITS AND PIECES"

THE PHILADELPHIA ZOO has opened its new Small Mammal House to the public. The building houses three exhibition areas—a Nocturnal Room, the Rotunda, and a Diurnal Room. The Nocturnal Room is equipped with red light illumination and has 15 exhibits, glass fronted, which contain animals such as Vampire Bats, Ferrets, Pottos, and Skunks.

THE NEW Milwaukee Zoo's first guidebook is now available. The 64-page publication features color photographs of the zoo's animals and exhibits.

RING-TAILED LEMUR twins born in March are reported doing well at the San Francisco Zoological Gardens. The young lemurs can be seen near the zoo's service entrance.

THIS YEAR'S FIELD COUNT of the California Condor has produced a count of 51 of the giant birds. Last year, 38 of the rare condors were sighted. Approximately a quarter of the condors spotted were believed to be young birds.

Would You Believe— THE KIWI?

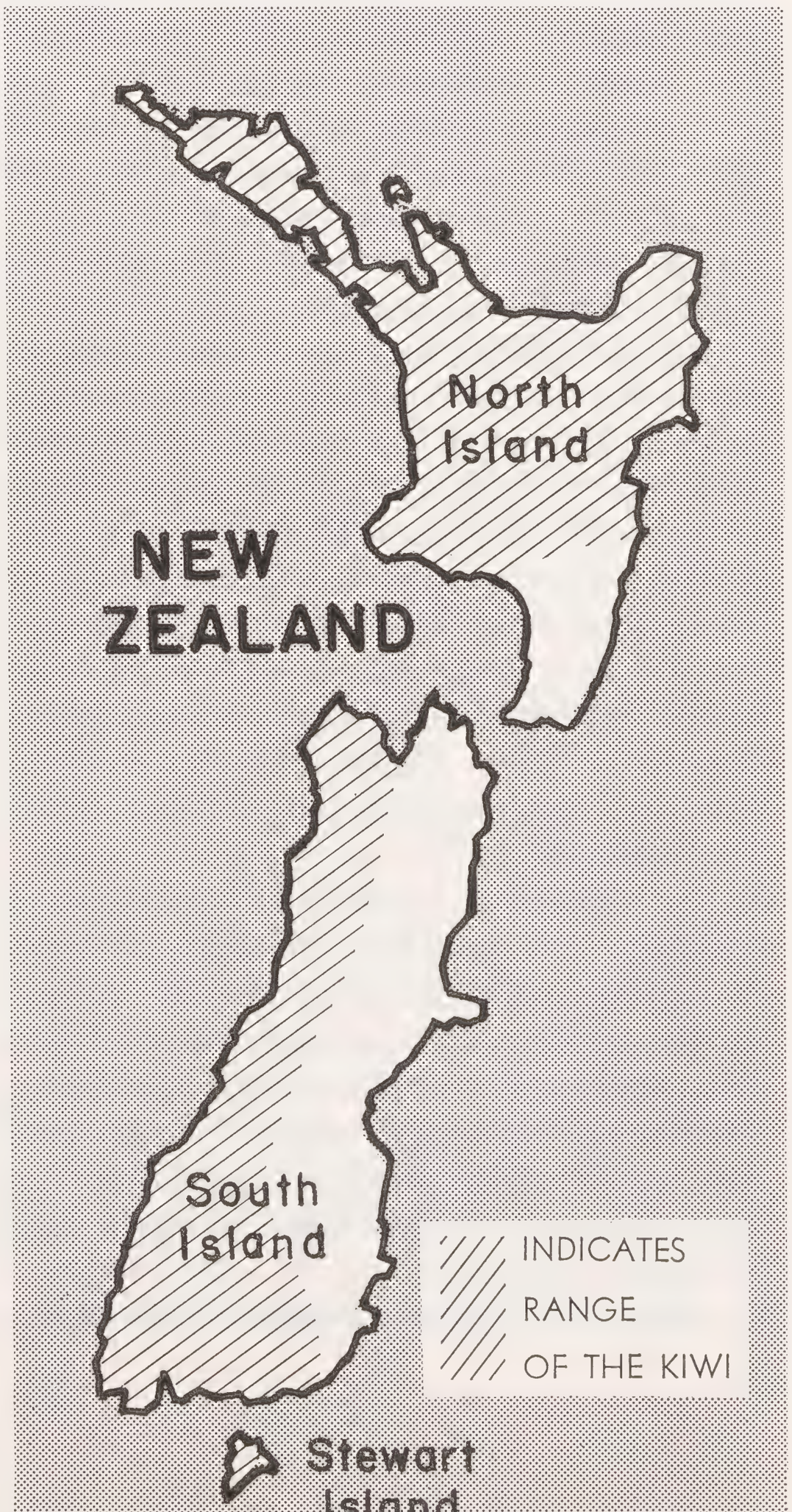
By DAL STIVENS

THE FIRST SPECIMEN of the kiwi brought to Europe early in the last century, not unnaturally, aroused some skepticism among naturalists. The *Providence*, under the command of Captain Barclay in 1813, had come by way of India — enough to put any self-respecting scientist on his guard because of the impostures which were practiced on European adventurers. Eastern taxidermists were skilled in constructing non-existent animals for sale to simple-minded seamen. (One of their more daring creations was the so-called "Eastern Mermaid" that had the forepart of a monkey cunningly stitched to the tail of a large fish).

Plunging into the damp beech forests of the South Island of New Zealand, Captain Barclay's men had, indeed, caught an extraordinary tailless bird, about the size of a domestic fowl with stumpy wings the size of those of a newly-hatched chicken, stocky legs and an absurdly long bill. It was unable to fly and its greyish-brown and reddish feathers were silky-soft and like fur; astonishingly, the creature looked more like a rat than a bird. Rodent-like, too, were the whiskers round its mouth, its stealthy gait and its alertness; ready to dart off at the slightest sign of danger. Moreover, it made strange snuffing sounds while hunting for food; scratching away heaps of rotting leaf-mould with claw-like feet. Its name, the Maoris told Barclay, was "kiwi" in imitation of its shrill repeated call.

The Antipodes stretched the imagination of early naturalists. A few years earlier, Australia had produced a bird-like mammal in the platypus; now New Zealand had come up with a mammal-like bird. When the wondering naturalists began examining specimens, other mammal-like characteristics were discovered in the kiwi. Most birds have superb eyesight and a rather poor sense of smell. Most mammals depend mainly on their sense of smell rather than their eyesight. However, scientists soon discovered that the nocturnal kiwi had very poor eyesight — its range is about six feet — but it had highly developed olfactory centers, with large nasal passages leading to the nostrils at the extreme tip of the beak.

It is hard not to look at any creature subjectively. Most people find kiwis comical. I have watched a crowd of people shrieking with laughter at a kiwi feeding in the twilight, shuffling over the leafmould, listening and prodding with its bill, much like a blind man tapping with a stick. The kiwi is no clown but a very efficient hunter of worms, snails, insects and grubs. Its long bill, sensitive to both scent and touch, and its acute hearing enable it to find food without much use of the eyes. And it is an adroit tweaker-out of worms, tugging at the soft worm, firmly but not too sharply; otherwise the soft worm would break.



The Apteryx australis, **the one species of kiwi common to all three main islands of New Zealand, leaves its burrow (left) to forage in the forest at night. Another two species of this odd bird are confined to the South Island.**

It then leans backwards and waits patiently until the worm's muscles tire.

Nature is frugal and there we have the clue to the kiwi, which once flew and then returned to the ground and acquired many mammal-like characteristics. During the Cretaceous Period, some 60 million years ago, the land bridges between Asia and Australia and New Zealand were broken. Birds earlier had made their way to New Zealand but no mammals were able to follow, except for two species of bats and sea mammals such as whales, dolphins and seals. In the course of evolution, birds acquired flight for two main reasons: safety and food. Mountainous and primeval New Zealand was thickly forested; there was an abundance of food and no predators other than hawks. Several kinds of birds returned to the ground and became foragers on the rich forest floor and slowly, over the years, lost the power of flight. They included the kiwis, the kakapos (ground parrots), the takahes and wekas (members of the rail family), and over 20 species of now extinct moas. At least five other New Zealand birds are poor fliers and if they survive man and man's introduced predators they may still lose the power of flight in some distant age.

The great flying muscles of flying birds are anchored to a keel on the breastbone; kiwis have no keels. And the barbs of their feathers lack the interlocking zip-fastener-like mechanism you find in most feathers.

There are three species. One, *Apteryx australis* is common to all three main islands — North Island, South Island and Stewart Island — and is light brown in color. The other two species, *A. haasti* and *A. oweni*, are silvery-gray and spotted and are confined to the South Island.

For millions of years these birds lived securely in the worm-rich New Zealand forests, hiding up under tree roots and in burrows during the day and emerging to feed at night. They could sprint swiftly or put up a formidable defense if brought to bay. Touch a wild kiwi and it kicks forward its steely foot and strikes downwards. Kiwis fight savagely in the breeding season.

Most New Zealanders never see the forest-

haunting nocturnal kiwis except in zoos, although they sometimes hear the male calling to his larger consort or challenging another male. The calls, rather like shrill whistles, are rarely heard during the day when the birds are usually slumbering, blinded by the sunlight.

Kiwis mate in the New Zealand spring and the breeding season extends over several months. They are monogamous and, it is claimed, they stay paired for life. (In captivity kiwis have lived for 20 and even 30 years).

Even in egg-laying, kiwis confounded early naturalists. There is some relation between the size of birds and the weight of eggs they

Young New Zealanders watch kiwis at a game farm dig for worms. The bird's long bill, sensitive to touch as well as smell, coupled with its keen hearing, enable the kiwi to ferret worms from the soil without much need of sight.

lay. Large birds usually lay relatively smaller eggs than smaller birds. A small bird such as a finch lays an egg about a ninth of its own weight, and a very large bird such as an ostrich lays an egg weighing only one-fiftieth of its own body weight. For many years it was argued that birds could not lay larger eggs because they were unable to put into one shell a larger proportion of their body materials.

Then came the discovery of a female kiwi, weighing about seven pounds, which laid an egg one pound in weight, four-and-a-half inches long. To match this proportionally, an ostrich would have to lay an egg in the neighborhood of 40 pounds.

Mated kiwis select a nesting hollow in a tree or log, or among roots, or they may dig a hole in a soft bank. They line it with feathers; the female lays her two prodigous, greenish-white eggs and then the male takes over. The male lies across the two eggs, his narrow body not quite big enough to cover them. If you disturb the male during incubation he becomes savage, snarling and hissing like a cat. At dusk he is said to leave the nest to feed hurriedly and return to his brooding. By the time the 10-week incubation ends, he has lost much of his body weight.

Even kiwi chicks are different. The chick's eyes are open at hatching and its color is almost black. Unlike most other chicks it has no down, and some of its feathers are almost an inch long. In fact, it looks exactly like an adult bird. When the chicks are only six days old they are strong enough to leave the nest to search for food and immediately begin digging their bills into the ground in search of worms. By two weeks they are self-sufficient and can run very swiftly, although they tail along with father for some weeks. (The mature state of the chicks when hatched is a probable reason for the large size of the eggs. The mallee fowl of Australia, whose chicks are also well advanced when hatched, also lays proportionately large eggs).

The archaic kiwi, with its highly specialized bill, was safe in the damp, wet, wild forests of New Zealand until the Maoris came in seven long carved canoes about 600 years ago. These brown-skinned Vikings of the Pacific hunted them at night with the lean, small dogs they brought with them. On the necks of the brown and black dogs they tied tiny rattles so they could keep track of them. They also carried glaring torches to dazzle and confuse the birds.

The hunters prized the bird's flesh and their soft, fur-like feathers, which were laboriously stitched singly on to flax to make cloaks for chiefs of the highest rank. The feathers of

The kiwi lays only one egg per breeding season, but it's a whopper. A seven-pound female kiwi produces an egg weighing a pound. If the same ratio applied to the ostrich, it would have to lay a 40-pound egg.

albino kiwis were particularly sought. Kiwi cloaks were prized heirlooms and some preserved in New Zealand are hundreds of years old. Nonetheless, the Maoris were conservationists, to some extent. Taboos protected the birds and restricted the numbers which could be slain. Kiwis could only be hunted after the people had fasted on the day of the hunt. When the first kiwi was caught its roasted heart was offered to Tane, the god of the forest.

Europeans came increasingly from 1800 on, first sealers, then whalers (some from America), and then farmers. They knew no taboos. They hunted the kiwis and they chopped down their forest homes. Succulent kiwi pies were baked in pioneer ovens; skins were made into caps and their leg bones used as pipestems. One settler told a disapproving naturalist in 1861 that with the aid of two dogs he could catch 15 to 20 kiwis every night, and that he and his men lived on kiwi meat. Even worse, the settlers introduced stoats and weasels. European rats introduced themselves. By 1840, the kiwi population had declined drastically on the North Island. Diffenbach, a naturalist, travelling through the North Island in 1840, could get only one skin in spite of large rewards offered to the Maoris. A little later, another naturalist, Hochstetter, was unable to procure a single skin.

Collectors were almost as big a threat as the settlers. Sir William Buller (1838-1906), the first New Zealand-born naturalist, put many collectors in the field and sold kiwis and other birds profitably abroad to collectors like Lord

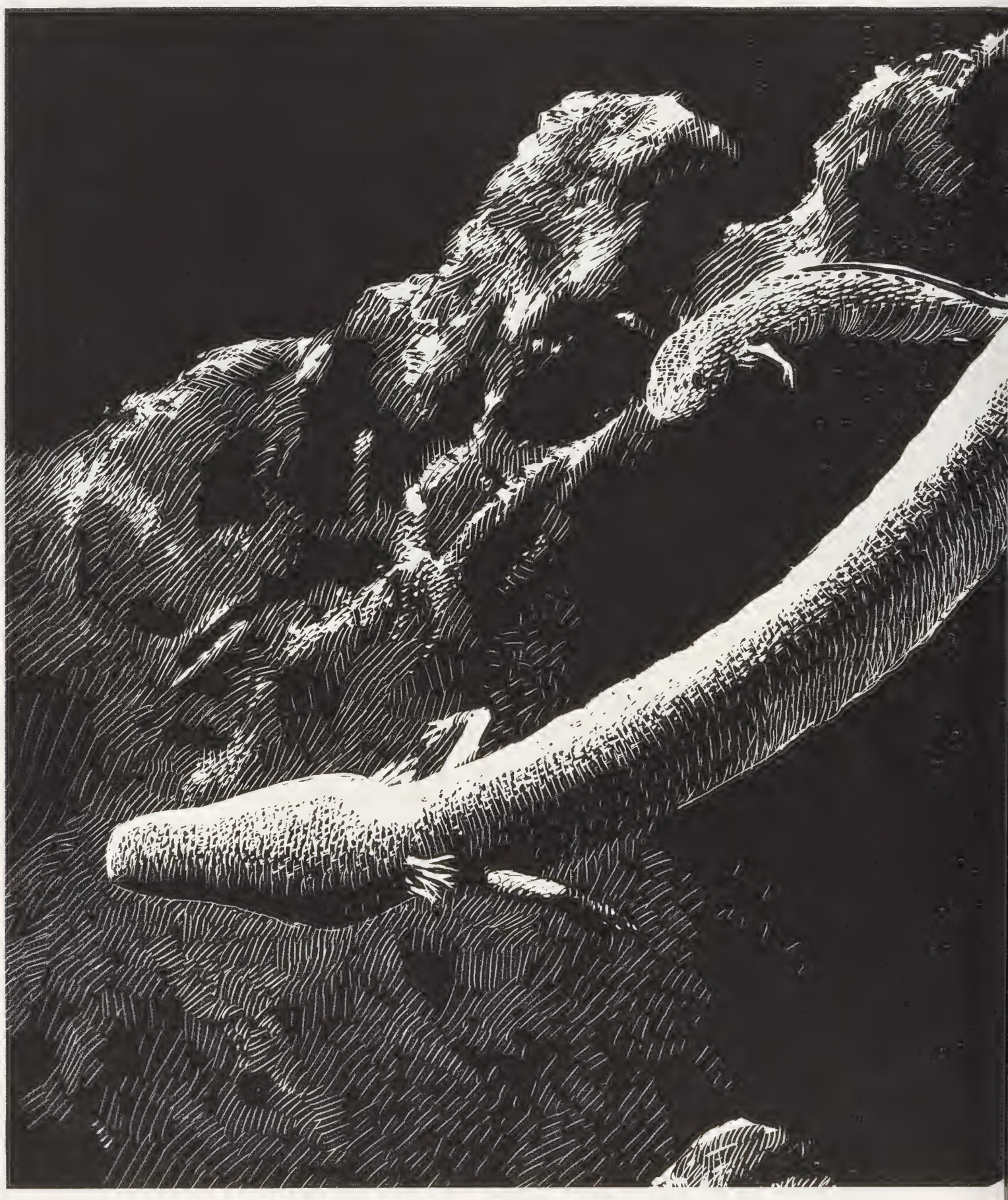
Long bills probing leaf mould on the forest floor, a North Island kiwi and its chick search for worms. Once a worm is caught, the kiwi patiently tugs until the worm's muscles tire. Kiwis also eat grubs.

Rothschild, whose boast was that he kept the largest flock of live kiwis in the world. (In 1913 Lord Rothschild had 171 skins, 15 skeletons and 144 eggs). Buller was always urging his fellow New Zealanders and overseas museums to procure specimens of rarer New Zealand birds, before they became extinct. Early accounts of large numbers of kiwis and other birds (some now extinct) being shipped abroad in the 1890s to perish in the uncharitable European winters and of specimens being shipped to European museums make melancholy reading today. The only consolation one gets are the frequent complaints about the hard work involved in digging up enough worms to sate the large appetite of the kiwis.

Equally important in reducing kiwi numbers was the destruction of habitat for settlement — about four-fifths of New Zealand's forest fell before the axe.

But public conscience in New Zealand was slowly awakening, stirred by a new breed of naturalists who preached conservation and stressed that the kiwi was a unique archaic bird which should be preserved. Early in this century the New Zealand Government declared the kiwi an "absolutely protected bird" throughout the country. It came probably just in time. Today there is no immediate concern. The birds seem to be maintaining themselves in native forests and New Zealanders are keen to preserve what has become an unofficial national emblem featured on coins, stamps, bank notes, the noses of aircraft, and the bows of ships.

RARE IS THE ZOO that can claim it exhibited the only example of a particular species. Yet, there died recently at the New York Zoological Park, an animal that was for two years the only example alive in all of North America of a rare cave salamander. This unique and unusual creature was the olm, *Proteus anguinus*, found only in the subterranean rivers and lakes of Yugoslavia. For five years it could be seen placidly swimming in a small aquarium located just inside the main entrance to the reptile house. This olm was the remaining survivor of a group of eight sent to Dr. James Oliver, then curator of reptiles and now director of the American Museum of Natural History, in November of 1961. Eight years previous to that, Dr. Oliver had shipped several young alligators and caimans to the aquarium at Maribor in Yugoslavia in exchange for an unspecified number of olms. For some inexplicable reason, it took from 1953 until 1961 for the director of the Maribor Aquarium to



OLMS

OF SUCH ARE LEGENDS MADE

obtain the necessary clearance for shipment of the eight olms.

At the time of their arrival in 1961, there may have been several olms still alive in the private collection of a professor of biology in the western United States. This herpetologist had obtained 40 olms in Yugoslavia in the mid-1950's and had brought them back to the United States. None of these survive today, but his collection was the source of many of the preserved specimens found in American museums today. They also served as the subjects of several series of interesting photographic studies of the olm that appeared over the past ten years.

In 1965, while visiting a subterranean biological laboratory directed by Marko Aljancic in Tular jama, Kranz, northern Slovenia, I noticed a large number of olms being maintained in what had formerly been a German-constructed air raid shelter. Professor Aljancic was eager to exchange some of his specimens for American salamanders. I mentioned this later to Dr. Thomas Poulson of Yale University who was also in Yugoslavia at the time and who has the most complete facilities in this country for maintaining large populations of aquatic cave animals, outside of a cave itself. Dr. Poulson arranged for the exchange. After the usual time-consuming negotiations about customs, shipping, etc., it was possible to bring back four live olms to the United States. Dr. Poulson planned a whole series of observations on these. Unfortunately, less than a year after obtaining them, all died one night due to an accident in Poulson's laboratory.

Hence, the lone olm that was on view at the Bronx Zoo was, for several years, the only one alive on this continent. What is so unusual about this salamander that would make it such a rarity? Oddly enough, this animal has been known for at least 400 years and was accu-

Known for about four centuries, the olm remains a zoological puzzle. This salamander—inhabitant of European caverns—is a true dweller in darkness. Its embryos perish under light of a 100-watt bulb.

By BROTHER G. NICHOLAS, F.S.C.

rately described by Baron Johann Weichard Valvasor in 1689 in *Die Ehre des Herzogthumus Crain.* The Austrian anatomist Laurenti scientifically described and formally named the olm *Proteus anguinus* in 1768. However, it was (and still is) the source of legends among the inhabitants of Carniola. Although normally the olm is found only in caves, it may be washed out into the lakes and poljes of the surrounding valleys at times of flooding. Because of a vague resemblance to a human embryo, it is called the "human fish" by local

inhabitants. It is neither human nor fish, of course, but the pale, elongate body with four appendages terminating in what seem to be tiny hands and feet has been the basis for much rather unscientific speculation. Ironically, and a source of frustration to scientists anxious to study the olm, so many of these "human fish" may be left on fields after the flood waters recede that the residents feed them to the pigs.

The olm is the only true cave-dwelling vertebrate in all of Europe. This is a rather startling fact considering that just in the United States there are over a dozen species of fish and salamanders that are true cave-dwellers. These are referred to technically as troglobites, which means they live their whole life cycle in caves and could not survive if removed from the cavernicolous environment. Why there should be no other cave fish or amphibians is a mystery. Certainly, the caves in Europe have been extensively explored so that it is doubtful that any unknown species of salamanders exist in subterranean lairs.

THE OLMS on exhibit at the Bronx Zoo were about eight inches in length, which seems to be the average for this animal. Several olms 12 inches in length have been reported from caves in Postojna, specifically from the famous Postojna jama or Adelsburg Grotto. (These names pertain to the same cave; the former term is used when referring to Yugoslavian ownership and the latter when referring to German or Austrian occupation.). As adults, the olms lack eyes and seem to be totally lacking in pigment. The gills are a brilliant red in contrast to the pallor of the remainder of the body. This is due to the concentration of blood vessels in the gills. There are also lungs present and both are used for respiration. Though blind, olms can detect food both by means of a keen olfactory sense and the ability to detect even minute vibrations in the water. Just what they feed on in the caves is not certain, although probably they prey on small worms, aquatic insect larvae and eggs, and small crustaceans. The olms at the Zoo lived on a diet of tubifex worms and bits of liver dropped into the aquarium twice a week. Olms have existed for as long as two years without eating anything and maintained their normal activity during this period. The only obvious result of this long fast is a decrease in length.

BECAUSE the olm lives its whole life cycle in the dark, often inaccessible (to humans) recesses of a cave, little has been known of its life cycle, physiology and behavioral patterns. In an attempt to observe the olm throughout its whole life cycle, Professor Albert Vandel, director of the Underground Laboratory of the Centre National de la Recherche Scientifique, Moulis, France, established a population from Yugoslavia in his laboratory in 1952. Since then he and his co-workers have gradually developed a breeding population. Since the olm normally lives in deep, swiftly flowing underground rivers, Professor Vandel decided to raise his olms in running water, maintained at about 55° F. and in total darkness. Although the olm is a hardy animal and will survive in a small aquarium, it breeds only in water that is constantly being changed. Vandel's olms live in tanks 30 feet long and 3 feet wide. The bottoms of the tanks are covered with a layer of cave mud since the olms prefer to burrow in tunnels in the mud. Adults could be maintained in light with no apparent injury, aside from a gradual increase in pigmentation, but the eggs and embryos are sensitive to illumination and are killed by the light from a 100-watt bulb. Stones are placed in the tanks since the eggs of the olms are attached to the underside of these stones. Only well-fed animals have been found to reproduce so Vandel and his associates feed the olms crustaceans, aquatic insect larvae, earthworms, small fish and tadpoles.

For a long while, it was not clear whether the olms were true egg-laying organisms or if they hatched the eggs within the body cavity to give birth to live young. Vandel and several other investigators have now definitely established that the olms do lay eggs. The report of young being born alive must be regarded as a pathological phenomenon.

The olms are neotenic creatures, meaning that they can reproduce even in an apparent

larval or immature state. The olms never lose their gills and move onto land as do most salamanders. (The olm is not the only neotenic salamander. Certain western subspecies of the Tiger Salamander do not metamorphose, but breed while in the gilled stage. Lack of the proper amount of iodine in the diet of these salamanders has been tagged as the probable cause of this condition. Tests have shown that larval salamanders will not mature after removal of the thyroid gland unless the salamanders are given thyroid extract in their diet. The Eastern Tiger Salamander however, loses its gills and matures after living in the larval stage for a period that may range to months. Thereafter, the Eastern tiger lives the rest of its life as a terrestrial creature. It is the largest land-living salamander in the world, reaching a length of more than a foot.)

The male and female olm engage in a nuptial dance, after which the male deposits a packet of sperm which is taken into the body cavity of the female where fertilization results. Vandel has noted that the eggs are not laid all at once but for a period of up to three weeks. Normally from 20 to 60 eggs, 8-9 mm. in diameter, are laid and placed on the bottom of flat stones. The parents remain nearby and maintain a circulation of water by waving their tails. This prevents mud from settling on the mucilage which envelops the eggs. It is the mucilage which enables the egg to adhere to the stone on which it is laid.

The egg hatches anywhere from 100 to 120 days after being laid. In the cave environment the eggs apparently hatch between the months of September and March. This corresponds to the period of flooding in the caves when food would be more common.

At hatching the olm still has a reserve of yolk which appears as a whitish mass on the underside of the body. It takes about one month for the yolk to be resorbed. For the next four months the olm, now in its juvenile stage, becomes more active. This juvenile stage is nearly twice as long as in *Necturus maculosus*, the mud puppy of the United States and the only other salamander closely related to *Proteus*. After the conclusion of the juvenile stage, the growth rate is extremely slow. It takes from eight to ten years to reach a length of six inches, at which time the olm becomes sexually mature. The life span of the olm is unknown, but it may exceed 30 years. This slow rate of development is characteristic of most true cave animals.

When the young larva hatches it appears to be gray. This is due to a scattering of black chromatophores, or pigment cells, over most of the body. This pigmentation develops in total darkness and persists for several months. After about one year the coloration begins to fade, and by the age of 18 months the olm is completely white, except for the gills. If the larvae are raised in the light, they retain this pigment and may become even darker. This difficulty had been partially offset at the Bronx Zoo by raising the olms under red light. As a result, only minor pigmentation had resulted at the time of death.

In the larval state a primitive eye is visible. However, it is non-functional, lacking a cornea and having only poorly differentiated visual cells. The lens never has any fibers differentiated and the optic nerve is extremely thin. However, this nerve is complete and reaches the brain. The eye stops all development within three months after hatching. This is followed by a period of ocular regression. The eye is discernible as a tiny dot even in individuals three years of age but after that becomes completely invisible. This is true even for olms raised in the light. An adult olm shows no external evidence of eyes at all.

Meanwhile, the olms that lived in the Zoo are now serving science as the objects of intensive study by anatomists attempting to learn more about the histological and embryological development of the eye. Since ocular development ceases at a comparative early stage in the olm a study of this abbreviated development may enable biologists to understand the complex interaction of the various tissues involved during the early development of the eye. For most people, though, it would be far more interesting to once again be able to gaze upon the graceful gliding movements of one of the most unusual amphibians in the world.

A NEW BOOK — ABOUT THE BRONX ZOO'S LION FAMILY

PRIDE'S

Text and photographs from "Pride's Progress: The Story of a Family of Lions," copyright © 1967 by Emmy Haas; reprinted by permission Harper & Row, Publishers, Inc.

ROGRESS

Review by JOHN MILLER

PRIDE'S PROGRESS: The Story of a Family of Lions. By Emmy Haas. i-xii, 113 pp., 168 black & white photographs by the author. Harper & Row, New York, 1967. $5.95.

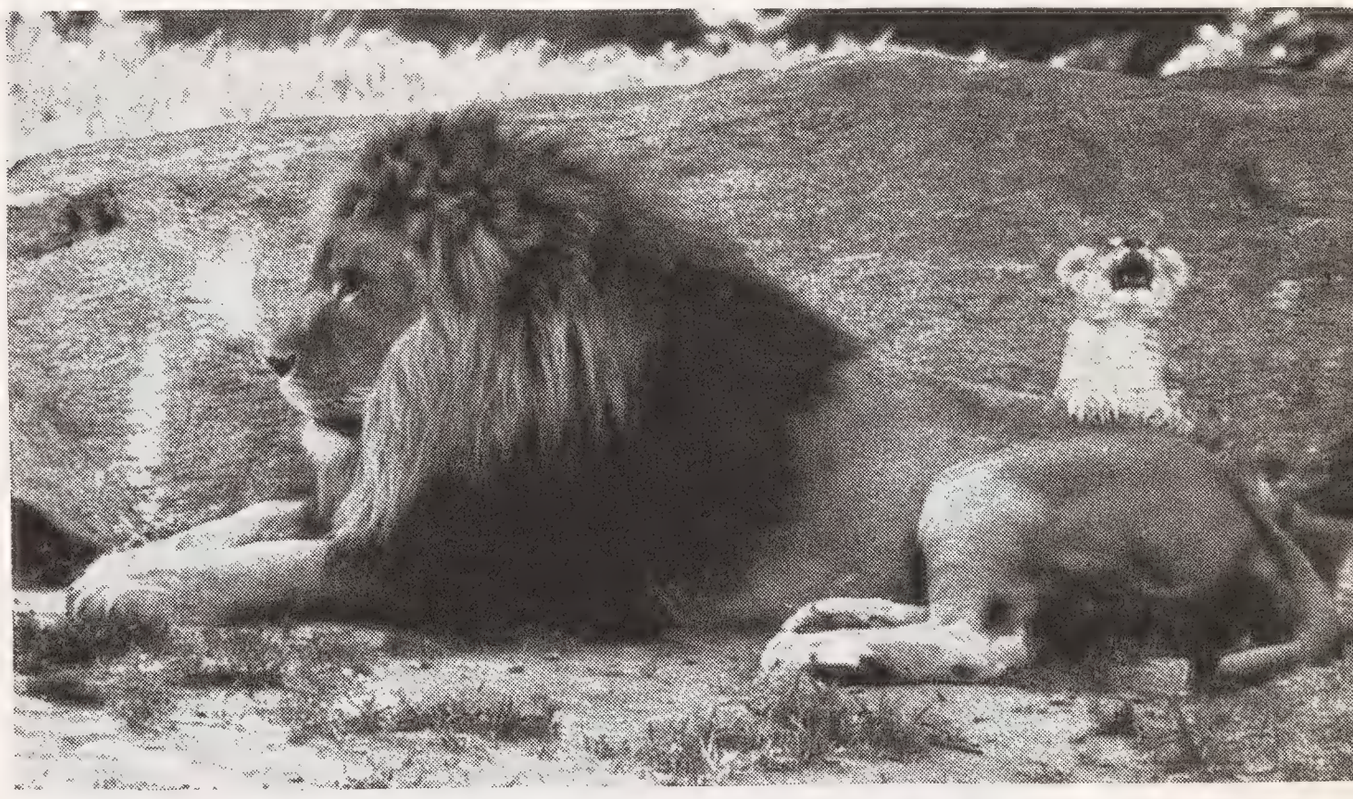
THIS BOOK is thoroughly delightful for two reasons: first, it is beautifully done and, secondly, it's about a family group (pride) of lions at the Bronx Zoo. Who could ask for anything more than a fine document about the home team!

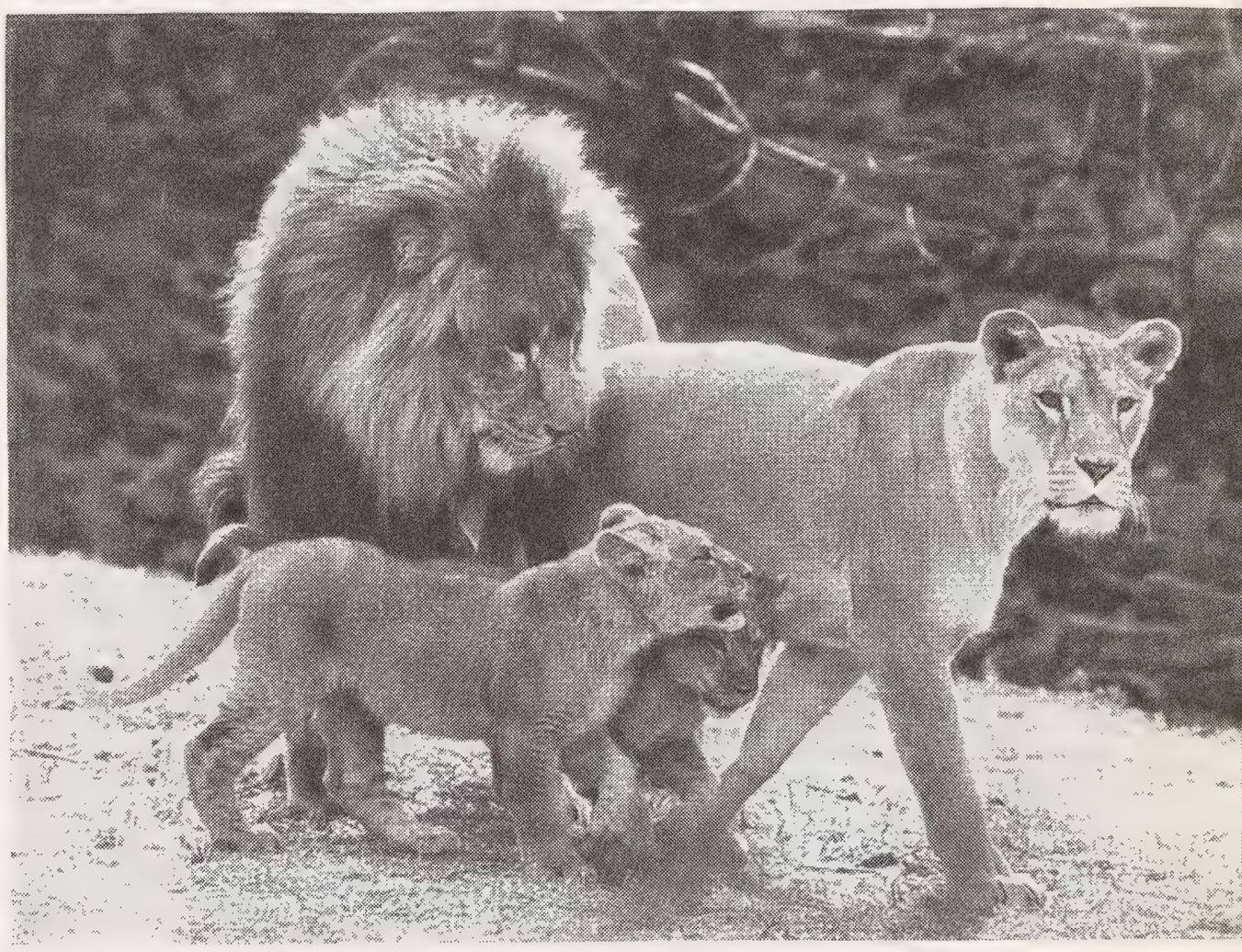
With 168 photographs – almost all of them excellent – spread over 113 pages of text, this is a book for young and old. Teenagers and up will find Miss Haas' perceptive observations of interest and the illustrations can be devoured by youngsters right down to post-infancy.

As Joseph Davis, former Curator of Mammals at the Bronx Zoo, points out in his introduction, ". . . what began simply as a photographic project has led Miss Haas to delve deeply into the literature on lions and, more importantly, to focus not only her camera but her powers of observation on the young pride of lions in the zoo."

For several years we have enjoyed Emmy Hass photography in this publication and in two books by our former colleague William Bridges, "Ookie, the Walrus Who Likes People" and "Lion Island." Now we get a book that is all hers and the results are far from disappointing.

Charlie, the male lion, and Princess, his mate, both came to the Zoo as juveniles in 1960. Not long after their arrival they were placed as a pair on the Lion Island exhibit at the south-central area of the Park. Miss Haas picks them up three years later and follows them during the warm-weather months of the years 1963-1965. The book deals with the author's observations on the relationship between Charlie and Princess and between them and their five cubs born in two litters during this period. (They recently had another litter of four).





Lions at home — Emmy Haas's camera has recorded a panorama of life on Lion Island. Her photographs depict the family life of a pride of lions with supreme accuracy, through scenes as those shown here.

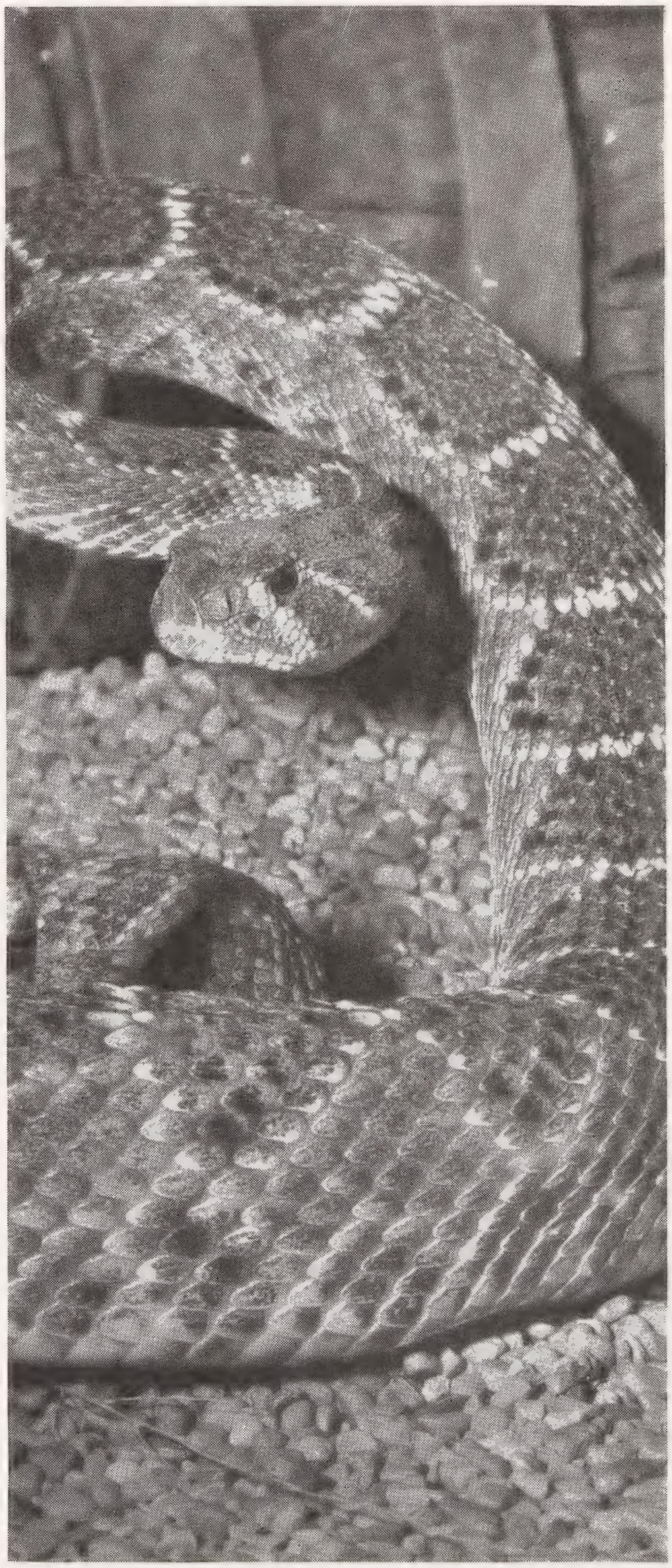
We predict (and hope for) many years of popularity and many future printings for this book, which just may contain the best series of photographs ever taken of one species inside a zoological garden.

MIXING IT UP IN

BROOKFIELD'S REPTILE HOUSE

By RAYMOND L. PAWLEY

Brookfield Zoo has kept the species shown here in mixed exihibits. At left (from top), Green Iguanas live with Morelet's Crocodiles; A Gaboon Viper with Boomslangs; and a Chinese Alligator with Lacerta Lizards. The Western Diamond Back (below) lives with a Bull Snake and a Striped Racer.



VOICING A SQUEAKY "BARK," the lizard launched itself into the air, aiming like a foot-long missile at the snout of a King Cobra. On target, it nipped the large snake, then quickly retreated. The lizard involved in this rather surprising confrontation was a male Tokay Gecko, large-mawed native of Southeast Asia. The skirmish with the equally Asiatic King Cobra took place not in a steaming jungle but in an exhibit at the reptile house of Chicago's Brookfield Zoo.

The cobra shares its cage with several Tokay Geckos, some of which have recently bred in the exhibit. Cobra and lizards have been entirely compatible, particularly since the male Tokay nipped the snake, one week after the geckos were introduced into the cage.

The exhibit is one of several in the Brookfield Zoo's reptile house that contain more than one species of animal, simultaneously displayed and living in harmony.

Because the reptile house has only 53 exhibit cages, it became practical to develop an increasing number of exhibits with mixed species. Mixed or "combination" exhibits satisfy the need to display a wide variety of reptiles and amphibians without building new facilities.

The practice of keeping more than one species in a single enclosure has long triggered debate among zoo men. Many authorities condemn the practice while others have maintained mixed exhibits quite successfully.

Mixed species exhibits probably stem from rather infamous beginnings. Many of the first mixed exhibits were most likely "dumping grounds" or catch-all enclosures where native turtles, snakes, lizards and such were placed at random.

Only in very recent years has any amount of sophistication been developed in this area of zoo technology. Combining species in an exhibit opens a Pandora's Box of problems — not the least of these being the inclination of some species to view others as potential meals. With proper planning and presentation, however, mixed exhibits can succeed as unique attractions.

When the Brookfield Zoo decided to create mixed exhibits in the reptile house, we took stock of all available facilities that could be shaped to meet the needs of the project.

Fortunately, our exhibit areas are relatively spacious. At the same time, many enclosures

Brookfield Zoo has successfully maintained the Green Mamba (above) in an exhibit with two Ball Pythons. Such mixed exhibits are difficult to develop, but quite rewarding.

Looking like a leftover from the Age of Reptiles, this Marine Iguana (left) is one of a colony maintained in an exhibit with Tokay Geckos and land snails at Brookfield.

have high ceilings which allow doubling up of aboreal with terrestrial species.

At the north end of the building, for example, is a large, open "swamp" enclosure with glass-brick walls and skylights for illumination. Around the perimeter, growing out of simulated rock are several thick clusters of bouganvilla vines, rubber trees, banana trees, citris and "corn" (Dracena) plants.

A pool in the center of the display is inhabited by large, semi-aquatic turtles. Two young Morelet's Crocodiles recently collected in Tobasco, Mexico, are doing exceptionally well since they are too small to disturb their associates. Several species of smaller tortoises as well as the larger Aldabra, Galapagos and Yellow-legged tortoises are restricted to the enclosure's land area.

Two Green Iguanas and one sizeable Rhinoceros Iguana are also in the group. Originally we tried to screen the foliage plants from the iguanas so the reptiles would not strip the area of greenery. We attempted to accomplish this first through the use of electricity and later by a barrier of wire mesh. It appears, however, iguanas are barely susceptible to a moderate electrical charge. Moreover, they are masters at threading their way through small wire mesh openings or seams. Thus the iguanas now have "the run" of the swamps. Oddly enough, they leave the foliage alone and descend from basking spots to feed on the vegetable plates brought into the area by the keepers.

Two large, free-hanging branches are suspended six feet above the pool. A Boa Constrictor of less than six feet in length lives on each branch. Isolated from escape only by its fear of falling, a boa may remain treed for over two years if the environment meets the snake's needs. Moisture is provided by a mist from a hose every morning, plus a water receptacle affixed to the limb out of sight of the public.

Several smaller birds such as Society Finches, weaver birds, and buntings have done very well in the swamp. Three larger birds, African touracos, also did well . . . until they selected a boa's limb as a nighttime perch.

Another novel addition, two Cotton-top Marmosets, live freely in the swamp, scampering about the foliage. At first, we thought the pair would hide in the thickest portions of the foliage and thereby escape detection. But within two days the marmosets were causing some concern because of their familiarity with zoo-goers.

The marmosets would not only sit on the railing outside the enclosure, but would take tidbits from the fingers of visitors. For several weeks, there were constant reports by concerned visitors of loose monkeys in the building.

Fortunately, the marmosets finally took up

Even Brookfield Zoo's 252-pound Alligator Snapping Turtle can be displayed with other animals. In this case, the turtle's cage-mates are Cuban Tree Frogs. Structure in turtle's mouth is thought to be a lure.

daytime residence in the swamp. During the night, however, they moved to an enclosure at the south end of the building, living in foliage over a pool that contains almost three dozen large alligators.

Another successful exhibit includes two examples of the giant species of toad, the Blomberg Toad. These animals stay on the "shore" part of enclosure very near cold water that splashes down a simulated waterfall. A Garden Tree Boa has been in with these animals for over a year, living on a tree branch, in full public view, over the pool. Because the enclosure is relatively cool, and due to the warmth provided by a heat lamp hanging over the boa limb, the snake appears reluctant to investigate the cage beyond its basking spot.

The Anaconda exhibit displays two 18-foot specimens which live on the floor of the enclosure. The enclosure is eight feet high, and its upper level has been filled with several other species: South American Bronze-backed Frogs, a Cuban Toad, one Speckled Racer and Basilisk Lizards. This particular unit has given us a minimal amount of trouble and seems to be a favorite of visitors. After pausing to look at the Anacondas, they often spend a further moment or two watching the antics of the basilisks.

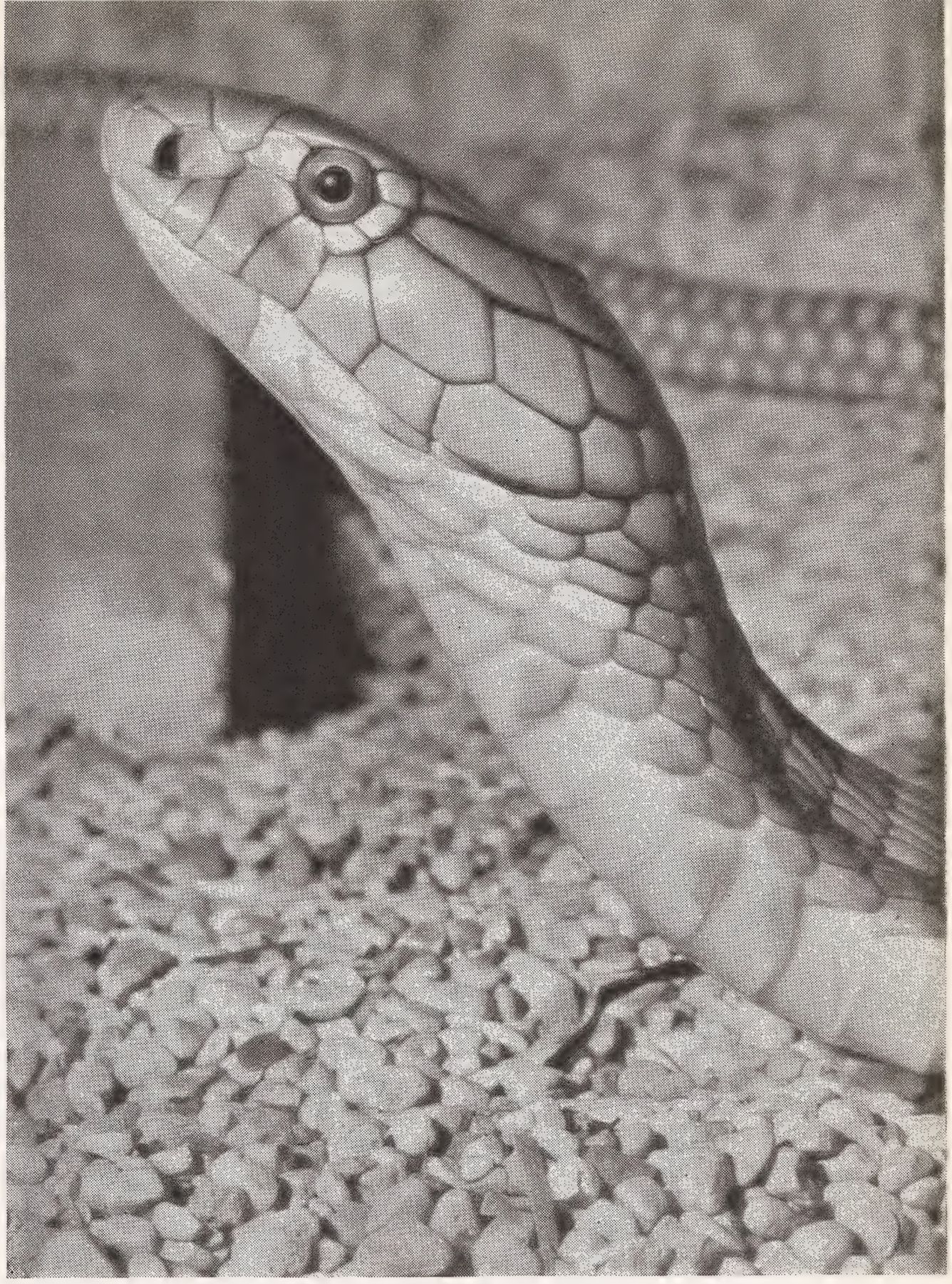
Not all mixed exhibits have been so successful. Our elderly Chinese Alligator gave no indication it would allow other animals to intrude in its domain. Some time ago, however, a small Indian Monitor of about six inches body length was placed in the alligator's enclosure.

Basilisk Lizards (specimen shown below) live in an exhibit with two 18-foot anacondas, South American Bronze-backed Frogs, a Cuban Toad, and a Speckled Racer. The anaconda enclosure is eight feet high.

For the first two days the lizard was properly fearful of the alligator resting in the pool. But as days went by, the lizard became more and more confident and even constructed a burrow in one of the plant pots. It then began basking on the log that spanned the alligator pond, high overhead.

The monitor became increasingly daring. In fact, after a few months, it was not uncommon to see it dash boldly across the cage using the alligator's back as a stepping stone! But no more than a week after this last example of careless abandon the monitor was to be seen no more.

In its place, a few Lacerta Lizards were added to the enclosure, and this smaller,



A King Cobra (right) noses about an exhibit that also houses several Tokay Geckos. The lizards are apparently so much at home that some of them recently have bred, despite the presence of the King Cobra.

quieter species appears to have adapted well to the exhibit.

Being engaged in this program, we have been quite impressed with the usually latent behavior patterns that come to light among specimens placed in mixed exhibits. A specimen kept in solitary confinement cannot exhibit the striking behavior patterns that emerge when two or more specimens or species are kept together.

In some cases, similar species in the same enclosure will tend to subdivide a cage into smaller units through a peck order or a territorial claim system and thereby deprive each other of the full utilization of the cage space. For example, iguanas will divide a cage in such a manner that one may inhibit the other so that neither gets the full benefit of the space.

On the other hand, dissimilar species pay little or no attention to each other. That way, both specimens get full use of the cage space. At the same time giving a specimen access to daily fluctuations of temperature and humidity found within the confines of a larger cage allows the animal to seek out its own niche and lead a more active life. This also gives a specimen the opportunity to be distracted by or react to another form of life in the same enclosure.

Admittedly, a combination exhibit program involves many risks. Its outcome can be chaotic unless considerable thought goes into planning. In preparing a mixed exhibit, it is wise to first consider the main physical characteristics and behaviorial traits of the key exhibit animal. Environmental needs are similarly crucial in designing the exhibit.

Once several species are installed in an exhibit, the animals must be kept under extremely close surveillance. Specimens in a combination exhibit soon settle into a behaviorial routine; normal cage routine can be turned upside down at any time, however, by thwarted breeding urges, the sudden awakening of an unfamiliar appetite or carelessness on the part of an animal.

Despite attendant problems, Brookfield Zoo is very satisfied with its mixed exhibit program. And so, it seems, are zoo visitors. There is every indication that the program will grow in the years to come.

THE BOOKSHELF

SOCIAL COMMUNICATION AMONG PRIMATES. Edited by Stuart A. Altmann. 392 pp. University of Chicago Press, Chicago, 1967. $15.00.

LEMUR BEHAVIOR: A Madagascar Field Study. By Alison Jolly. 187 pp. University of Chicago Press, Chicago, 1966. $6.95.

During the annual meeting of the American Association for the Advancement of Science in 1964 an international symposium was presented on Communication and Social Interactions in Primates. Dr. Stuart Altmann, who organized this very successful meeting, has edited a collection of the contributions — a valuable addition to the growing literature on the behavior of monkeys and apes. The five sections, on reproductive behavior, agonistic behavior, causal mechanisms, social dynamics, and communication processes, include both field and laboratory study, by people with backgrounds in anthropology, linguistics, psychology, and zoology. Each section is reviewed by a discussant, effectively unifying the treatment to a degree unusual in symposia of this kind. No serious student of primate behavior can afford to be without it.

One of its contributors, Dr. Alison Jolly, has also written a readable, entertaining and informative book of her own on the behavior of lemurs. The main subjects, the rather phlegmatic slow-moving Sifaka, and the more mercurial Ringtailed Lemur make an interesting comparison. They live together in the gallery forest on the banks of the Mandrary River in Madagascar where Dr. Jolly studied them for parts of two years. Their food and general habits, their relations to predators and to each other, and many aspects of their social behavior are described. Both seem to rely extensively on the odor of glandular secretions for social exchanges. Male Ringtailed Lemurs engage in what are described as stink-fights. The tail is rubbed several times on glands on the forearms and then raised and quivered above the back, facing towards the opponent. Apparently this wafts the scent towards the adversary and may successfully intimidate him. Such aggressive behavior becomes particularly frequent during the mating season, which in the Ringtailed Lemur is shown to be very short. A major part of the book deals with reproductive behavior, and a reexamination of the role of sexual bonds in keeping the troop together. There is a fascinating account of the behavior of a single male Brown Lemur in a troop of Ringtails. His success in dominance encounters, and his frustrations as a paramour are both attributed to differences in signaling behavior of the two species leading to misunderstanding at critical moments. There is provocative discussion of evidence for extreme inbreeding; the special social environment that confronts young primates including these prosimians; the relationship between sociality and intelligence, and many other issues. Future writers on primate behavior may find an example in the balance struck between factual descriptions and thoughtful discussion of their implications.

Peter R. Marler

HORSESHOE CRAB. By Robert M. McClung. 48 pp., profusely illustrated by the author, William Morrow and Company, New York, 1967. $2.95.

The importance of these "prehistoric" creatures in the economy of nature and as a zoological curiosity is described by Mr. McClung in an appendix to a well-written, simple story of the life of the horseshoe crab in the shallow waters of the North Atlantic. As usual, the drawings by the author are excellent.

R. F. Nigrelli

About the Authors

Alison Jolly holds a doctorate from Yale and has recently completed a study of lemurs in Madagascar. Her first article appears in this issue. **Brother Nicholas** is a member of the biology department at Philadelphia's LaSalle College. **Dal Stivens** is an Australian free-lance writer who has written several articles on animals "Down Under." That on the kiwi is his latest for this magazine. **Raymond Pawley** is general curator at the Brookfield Zoo. In his first article to appear in *Animal Kingdom*, he discusses maintenance of mixed animal exhibits.

ILLUSTRATION CREDITS

Cover — Frankfurt Zoological Gardens, p. 65 — Frankfurt Zoological Gardens; p. 66 — Alison Jolly; p. 67 — C. H. Fraser Rowell; p. 68 — Alison Jolly; pp. 69-70 — C. H. Fraser Rowell; p. 71 — (left) C. H. Fraser Rowell, (right) Alison Jolly; p. 72 — C. H. Fraser Rowell; p. 73 — Alison Jolly; pp. 74-75 — C. H. Fraser Rowell; p. 76 — Frankfurt Zoological Gardens; p. 77 — National Zoological Park; pp. 78, 80-83 — National Publicity Studios, Wellington, New Zealand; pp. 84-85 — drawing by John Schoenherr; pp. 88-89 — Emmy Haas; pp. 90-95 — Bill Winn.

Visiting Washington, D. C?

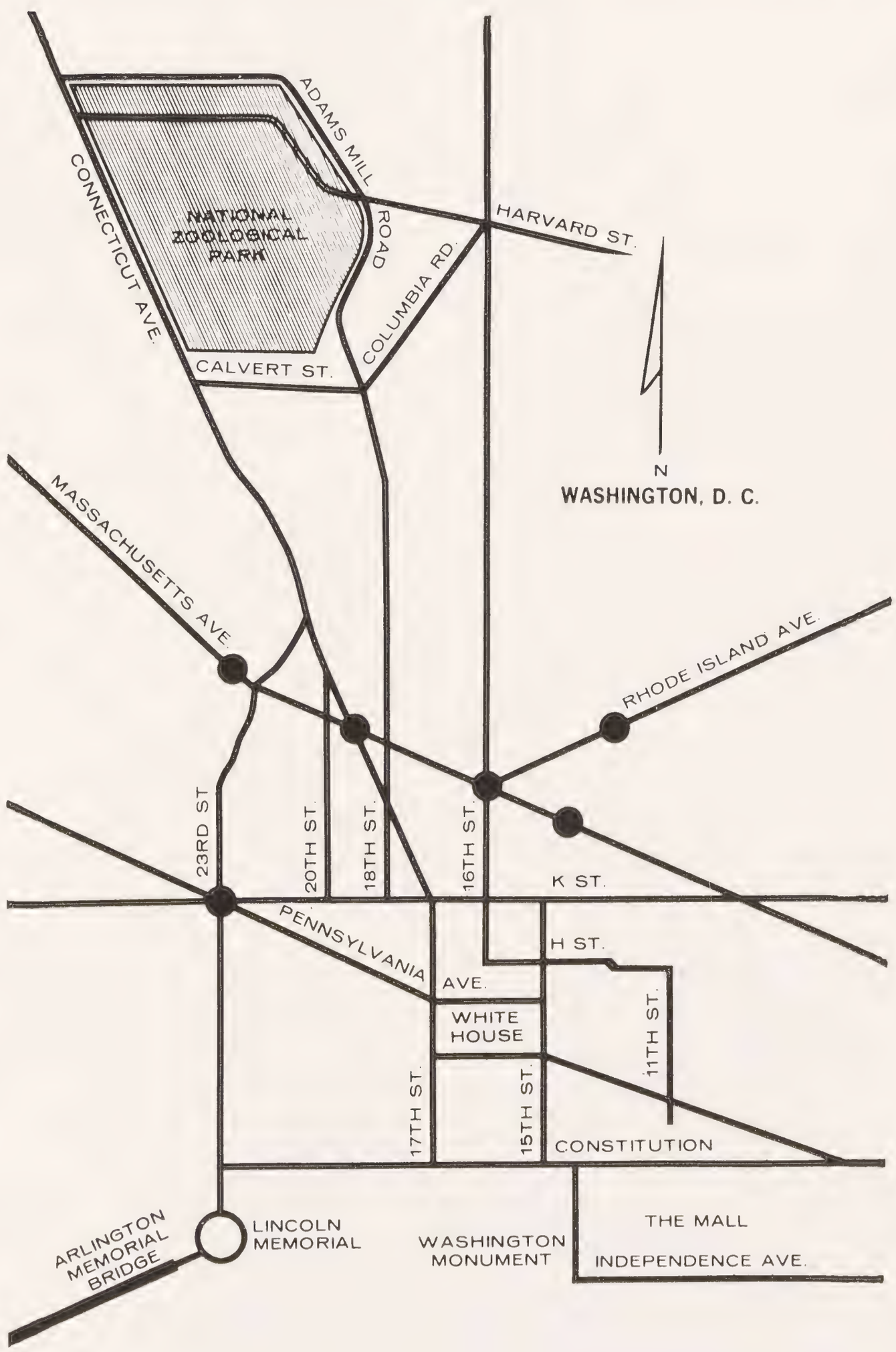
If so here's a handy travel guide to Washington's National Zoological Park.

The National Zoological Park was founded by an Act of Congress in 1889 and occupies a 175-acre tract in the heart of Rock Creek Park. It is the official Zoo of the United States Government, a Federal Agency administered by the Smithsonian Institution.

Here you will see one of the finest and most varied collection of small mammals in existence—including the rare and seldom exhibited Fossas of Madagascar.

Some of the unusual and interesting animals you "must" see when visiting this Zoo are:—the White Tiger, a large and well-established family of Two-toed Sloths, pairs of the Orang-utan and Lowland Gorilla with their young, family groups of Servals and Caracals. Of course—if you extend your visit to Washington, D. C. you may be able to see all of the 2600 animals exhibited in the National Zoo. It is open every day in the year.

The Main Entrance to the Zoo is opposite 3000 Connecticut Ave., N.W.



This is the first in a series of travel guides to zoos and aquariums to be published in forthcoming issues of this magazine. We welcome submission of maps and information from zoos and aquariums for this page.

NEW YORK ZOOLOGICAL SOCIETY

590.673
A59

X

animal kingdom

VOL. LXX, NO. 4, AUGUST, 1967

animal

MAGAZINE OF THE NEW YORK ZOOLOGICAL SOCIETY

CONTENTS

Rhinos, Whirlybirds and M99, 98
By N. J. Russell

Golden-naped Woodpecker, 106
By Alexander F. Skutch

Argentine Fauna: Time of Decision, 112
By Fernando Nottebohm

Animal Kingdom Reports, 119

Endangered! 122
By Peter Brazaitis

The Bookshelf, 128

Letters to the Editor, 128

About the Authors, 128

Illustration Credits, 128

Issued bi-monthly by the New York Zoological Society at the Zoological Park, Bronx, N. Y. 10460. Editorial and Subscription Offices at the same address. Title registered with the U. S. Patent Office. Subscription, $3.50 a year; single copy, 60 cents. Same rates for all foreign countries and Canada. Second-class postage paid at Bronx, N. Y. Send Form 3579 to Bronx, N. Y. 10460.

kingdom

VOL. LXX · NO. 4 · AUGUST, 1967

ABOUT THE COVER

The breeze that on these summer days parts the graceful willows on the Bronx Zoo's Gibbon Island reveals a new addition to the Zoo's white-handed gibbon clan. It's the twelfth offspring produced by a reliable old pair of white-handed gibbons, who are on the island for the summer. The adult gibbons arrived at the Zoo 25 years ago, when they were at least four years of age. Their first youngster was born in 1943. These excellent photographs of the female gibbon and her youngster were taken by Frank Stevens, a New Yorker who frequently spends the daylight hours at the Zoo, searching for subjects for his lens. By night, Mr. Stevens is a subway trainman for New York's transit system. The young gibbon shares the summer spotlight with some other new Zoo babies, described on page 121.

NEW YORK ZOOLOGICAL SOCIETY
630 Fifth Avenue, New York, N. Y. 10020

President
Fairfield Osborn

First Vice-President;
Chairman, Executive Committee
Laurance S. Rockefeller

Vice-President
Henry Clay Frick, II
Robert G. Goelet

Secretary
John Elliott

Assistant Treasurer
Eben W. Pyne

Treasurer
David Hunter McAlpin

Assistant Secretary
Harold C. Palmer

BOARD OF TRUSTEES
(*Executive Committee**)
Alexander Aldrich, George F. Baker, Jr.*, Robert E. Blum, William R. Coe, C. Suydam Cutting, John Elliott*, Charles W. Engelhard, Henry Clay Frick, II*, Robert I. Gannon, Peter R. Gimbel*, Robert G. Goelet*, Peter Grimm, John N. Irwin, II*, Warren Kinney, Anthony D. Marshall, Otto Marx, Jr., David Hunter McAlpin*, Peter Matthiessen, G. W. Merck, Charles W. Nichols, Jr., Fairfield Osborn*, Augustus G. Paine, II, Howard Phipps, Jr., John H. Phipps, John Pierrepont*, Eben W. Pyne, Laurance S. Rockefeller*, David T. Schiff, John M. Schiff, Henry Sears, Chauncey Stillman, Joseph A. Thomas, Landon K. Thorne, Jr., Alfred G. Vanderbilt, Robert Winthrop.

Ex-Officio:
The Mayor of the City of New York, Hon. John V. Lindsay
Administrator of Recreation and Cultural Affairs, August Heckscher

General Director
William G. Conway
John Tee-Van, *Emeritus*

ZOOLOGICAL PARK
William G. Conway, *Director & Curator of Birds;* Charles P. Gandal, *Veterinarian;* Hugh B. House, *Assistant Curator & Chairman, Mammals;* Grace Davall, *Assistant Curator, Mammals & Birds;* David W. Nellis, *Mammalogist;* Joseph Bell, *Associate Curator, Birds;* F. Wayne King, *Associate Curator, Reptiles;* Herbert J. Knobloch, *Curator, Education;* Charles B. Driscoll, *Superintendent, Operations;* Edward Kearney, *Manager, Facilities Dept.;* Lee S. Crandall, *Zoological Park Consultant & General Curator Emeritus;* Roland Lindemann, *Consultant, Mammal Management;* John M. Budinger, *Consultant Pathology.*

AQUARIUM
Ross F. Nigrelli, *Director;* Robert A. Morris, *Associate Curator;* Lars Mellkvist, *Superintendent, Operations;* Jewell Bungay, *Business Manager;* Louis Mowbray, *Research Associate, Field Biology;* Christopher W. Coates, *Director Emeritus.*

OSBORN LABORATORIES OF MARINE SCIENCES
Ross F. Nigrelli, *Director;* Martin F. Stempien, Jr., *Assistant to the Director;* George D. Ruggieri, S.J., *Coordinator of Research;* William Antopol, Jack T. Cecil, Harry A. Charipper, Kenneth Gold, Myron Jacobs, Klaus Kallman, Vincent Liguori, John J. A. McLaughlin, Martin P. Schreibman.

INSTITUTE FOR RESEARCH IN ANIMAL BEHAVIOR
(Operated jointly by the Society & Rockefeller University)
Donald R. Griffin, *Director;* Peter R. Marler, Jocelyn Crane, Roger S. Payne, Richard L. Penney, Fernando Nottebohm, George Schaller, Thomas T. Struhsaker, C. Alan Lill, O. Marcus Buchanon, *Resident Director, William Beebe Tropical Research Station.*

GENERAL
Walter Lerchenfeld, *Comptroller;* John McKew, *Personnel Manager & Assistant to the Director, Zoological Park;* Gordon Cuyler, *Membership Chairman & Administrative Associate;* Jerry M. Johnson, *Curator, Department of Exhibition and Graphic Arts;* Edward R. Ricciuti, *Editor & Associate Curator, Publications;* Dorothy Reville, *Assistant Editor;* Sam Dunton, *Photographer.*

AFFILIATE
Jackson Hole Biological Research Station
L. Floyd Clarke, *Director.*

RHINOS, WHIRLYBIRDS AND M99

By N. J. RUSSELL

WITH THE UGLIEST FACE in the animal kingdom and a truculent disposition, the black rhinoceros literally has a nose for trouble. It is the rhino's horn that has made this huge animal a prime target for poachers and has put the black rhinoceros high on the list of animals in danger of extinction. Rhino horn consists of compacted fibers, somewhat like hairs.

The rhino is a victim of ancient superstition. Many aging gentlemen in the Far East still believe that rhino horn is the basic ingredient for elixirs reputed to revive flagging sexual potency. As a result staggering sums are paid for rhino horn. Where there is demand there will be supply, and this law of economics filters back to the hunting tribes of East Africa, the last great stronghold of the black rhino.

Rhino poaching, that is, illegally killing the animals for their horns, is a lucrative source of income for some of the tribes. Since the crime takes place in thick bush miles from anywhere, it is difficult to prevent or even to control. And since rhino horn, unlike ivory, does not lose its value by being cut into portable pieces, it is just as difficult to catch the middleman who fences the horn to the agents at East Africa's ports.

The Kenya Game Department has evolved a battle plan to save the rhino. First authorities banned hunting and trapping of rhino except in one small area where safaris are restricted either to foot or horseback.

At the same time, game officials marshalled a powerful array of resources — advanced veterinary knowledge, improved techniques of

Head-on, Africa's black rhinoceros is the picture of truculence and power. A formidable foe, the black rhinoceros is nevertheless easy prey to poachers armed with modern weapons. Kenya authorities are taking steps to preserve it.

handling and using the immobilizing narcotic compound M99 and a pair of skilled helicopter pilots and their aircraft.

When extensive poaching is reported in an area, the Game Department moves in. One of the helicopters churns through the air seeking rhinos. Once a rhino is spotted, a drug-bearing dart is fired from the whirlybird. The massive pachyderm, drugged, is carted out of the thick bush by lorry and, after a rest period, transferred to the comparative safety of a national park.

It sounds simple, but it has taken years of trial and error to coordinate the program to the point where, on a recent operation, the game agency rescued 18 rhinos in six days.

Darting the black rhino started in the early 1960's, when the Game Department's capture unit was led by Mr. Nick Carter, who is now in South Africa. He, through trial and error, provided much of the groundwork later built upon by the next leader, Mr. Barrie Chappele, who was killed in an air crash while spotting rhinos, and the unit's present leader, Dr. John King, who has brought darting to a fine art. On loan from the British Government, Dr. King is a young Ph.D. as much at home in thick bush as he is discussing the finer points of veterinary technique. A qualified veterinary surgeon, he has learned his bushcraft from his fellow game wardens. His advanced veterinary knowledge provides the answers to the how, why and wherefore of studying the animals in the wild and under sedation, and in perfecting the "after-care" so necessary if the darted rhinos are to survive capture.

Over a period of two years in the Kenya bush, Dr. King has perfected the use of M99 against the black rhino. One of the major problems was to ensure that the dart carrying the drug penetrated the rhino's thick hide with just enough power to make it stick but not so much that the dart would bounce out again. He redesigned a dart which has a steel needle with the hole in the side of the stem to prevent it from clogging as it penetrates the hide. The dart also has a small barb to stop bounce.

The method of accurately firing the dart has also progressed from the early "crossbow days" to the use of a highly efficient large-bore rifle and cartridge which is 95 per cent accurate at distances up to 25 yards.

Efficient darts would be of little use, however, without the immobilizing agent M99. Previous compounds used to capture antelope would require a much larger volume of drug if used on rhinos – and it would be difficult to pack that much compound into one dart. Many immobilizing drugs also demand sure-fire judgment of an animal's weight before use.

The black rhino is not likely to oblige the hunter by waiting patiently for its weight to be assessed in the middle of thick, thorny bush country. Hunting from the ground, you normally get a sudden glimpse of either horn or rump, depending on luck. If rhinos sense danger they may run or charge. Therefore, it is almost impossible to accurately guess a rhino's weight, and the animals are so massive that a 10 per cent error is likely.

Fortunately, M99 eliminates the need for such accurate estimation of weight. Knowledge of how to use M99 has reached the stage where Dr. King now carries only two strengths of the compound and two quantities of each strength. A huge bull rhino gets a larger quantity of stronger compound; a calf gets a smaller amount of milder drug. But in a pinch M99 is so flexible that a small cow or a large bull can be darted with the same dose of drug without harm.

The use of M99, however, would not on its own have brought about the present revolution in rhino-catching without the helicopter.

Tracking rhino in thick bush and forest is a tedious and dangerous job. You need many eyes, half looking for the nearest climable tree in case of emergency – but in the bush there are often no trees. There are, however, searing heat, intense thirst, and an abundance of dry, brittle scrub-bush which impedes human vision, but not a charging rhino which bulldozes through brush as if it did not exist.

The odds are stacked heavily in the rhino's favor. Its eyes may be poor, but its hearing is acute and sense of smell above normal. Rhino hide is an inch thick in places, impervious to the thorns which snag clothes and vehicles. The rhino can thunder along at 30 miles an

Flushed from the brush by helicopter, a rhino lumbers over the pothole-scarred plain. A drug-bearing dart is fired at the rhino from the helicopter.

Once drugged, the "sleepy" rhino is snared with ropes by trappers who, riding in catching-cars, pursue the rhino after it is darted with M99.

As the massive rhino crashes to the ground, trappers go to work in earnest. Moving quickly, they hobble the drugged animal, which is still held by a rope.

hour for a short distance in this kind of country, cut by dry river beds and washaways. People on foot in the bush are in great danger of ending up second best to a charging rhino. Even trappers' "catching cars," built for the job, often end up impaled on a tree stump, after a heart-stopping chase across country.

Veteran trappers, with tough years of experience behind them, take an average of a week to catch a rhino by the chase-and-rope method. Often they spend four or five days tracking the animal to get within chasing distance. The helicopter, on the other hand, tips the balance in favor of the trapper. I found this out first hand.

To see the capture unit in action, I worked with it for a week during an operation in the Darajani area, on the banks of the River Athi. Across the river, easily forded during the dry seasons, stretches the northern section of the huge Tsavo East National Park. Unfortunately, endangered rhinos removed from Darajani cannot be relocated in the adjoining park. Rhinos are creatures of habit and extremely local. It would be useless to transfer them across the river, for they would recross it at the first opportunity and return to their old, poacher-ridden home ground.

Trimmed of the need for tracking rhinos from the ground the operation was so smooth as to be a little monotonous. In addition to a helicopter, the field party consisted of a Land-Rover and two large four-wheel-drive lorries, each equipped with a winch and wooden sledge.

A day in the field usually follows a set pattern. At dawn the vehicles move out to a rendezvous in the bush — possibly a hunting area honeycombed by countless winding tracks pounded out of the dust by thousands of animals over the years. The Land-Rover is in contact with the helicopter by radio. Twenty minutes after the vehicles set out, the helicopter carrying the pilot and Dr. King takes off and starts the hunt.

Within minutes the airborne hunters spot a rhino and the radio crackles into life, bringing the vehicles into position. This must be a smooth procedure for a drugged rhino should be hobbled as quickly as possible to prevent injury in case it blunders into rocks and trees.

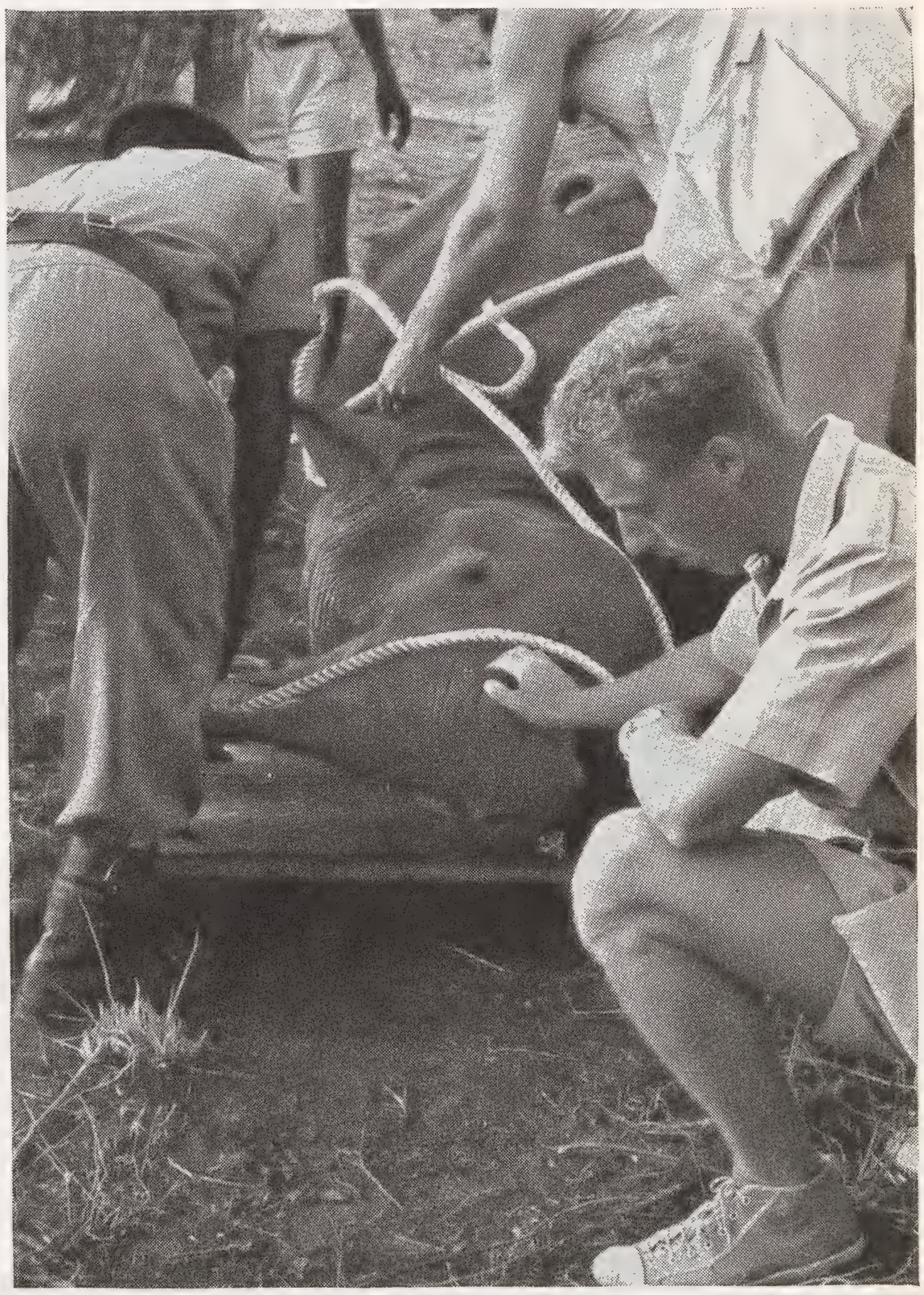
With the rhino in sight, the pilot swings his "chopper" in low and to the left of the target's rump, so Dr. King can take careful aim with his dart rifle. If he aims too low the dart may penetrate the skin at an angle so acute that the drug might not work. A dart aimed too high could be snatched up by swirling "dust-devils" which could blow it off target.

When the moment is right, Dr. King leans out of the helicopter against his safety harness and fires the rifle, sending the dart into the left buttock of the running rhino. The helicopter follows the rhino, while Dr. King watches for the first stagger that tells him the drug is taking effect. Then the vehicles are called in by radio.

It is often easier said than done. From the air, the bush looks thin. Potholes, antbear holes and washaway blend into the earth. But on the ground it can take 10 minutes of lurching and turning to cover 50 yards by vehicle. Even when the trappers reach the point beneath the slowly circling helicopter, the rhino may still be invisible until they are almost on top of it. The wispy-seeming bush has the properties of barbed wire. The rhino, tiny from the air, looms up with massive bulk and a long horn with which it can punch through a metal door.

But the vehicles go in anyway, and if the rhino is already down, it is but a moment's work to securely hobble the animal. Occa-

In Swahili it's called "pulli-heevi," but no matter what the language, hand-rolling two-plus tons of limp, drugged rhinoceros on to a sledge is just plain hard work.



Dr. John King, leader of the Kenya Game Department's capture unit, checks the breathing of the drugged rhino as other members of the unit rope the animal to a sledge.

Viewed from the air, capture unit vehicles and personnel dot the African plain. This photo was taken by the author from one of the helicopters.

sionally the rhino is still on its feet. One rhino walked round and round the assembled vehicles, then between them, unwilling to fold. At last one of the catching-cars crept round behind it. The trappers dropped a noose over the rhino's head and lightly pulled. With a great deal of whatever dignity a sleepy rhino can muster, the huge beast gently keeled over.

Once a rhino is down the work starts. Dr. King lands and checks the animal's respiration. The pulse rate, best taken at the base of the tail, is recorded. Girth at the heart, length, size of feet and horns are then noted — as well as time of darting, time of collapse, and the animal's sex. Half a dose of an antidote for M99 is injected into an ear vein and the rhino's eyes, dilated by the drug, are covered against the sun.

A great deal of what is called in Swahili "pulli-heevi" rolls the rhino onto a wooden sledge which is winched up roller ramps onto a lorry. Securely roped with its head cushioned to prevent damage in transit, the rhino is carted back to camp to be weighed — a feat of bush engineering involving three spring balances, two blocks and tackle, a lot of manpower and a convenient baobab tree.

With one lorry on its way back to camp, the helicopter is already scouting for another animal. A smooth repeat performance and another later in the day soon fill rhino pens, assembled by the trappers before the darting started. The rhinos rest for at least three days in the pens before they are crated and carried to new homes. This gives Dr. King time to study their behavior, which, in most cases, becomes amenable surprisingly fast.

Because the going is slow over the rough country, the three-hour "sleep" from M99 is often almost over by the time a rhino has been weighed and penned. Then Dr. King and his men wash down the animal with a strong insecticide (rhinos are often tick-infested) and pour healing oil on any open battle scars the rhino may be carrying. This done, and a head-rope attached, Dr. King injects the rest of the antidote.

Normally it takes about 10 minutes and a

Roped to the sledge, with its eyes covered and head cushioned, the rhino is winched aboard a lorry and transported back to the capture unit's camp. One of the unit's catching-cars is parked in the background.

Aboard the lorry, the rhinoceros is weighed. The men of the capture unit, using blocks and tackle, raise the animal and sledge clear of the lorry's deck. The animal's weight is read by three scales on the lorry.

tottering effort to bring the rhino to its feet. Occasionally, however, it takes only two seconds and a sudden surge. In such a case, members of the unit scurry for the top of the pen.

Once on its feet, a rhino is kept under constant observation, for rhinos have a habit of pushing against the nearest convenient object after awakening. If this happens in a corner of the pen, the rhino's horns can be damaged. The loose end of the headrope is passed along the top of the pen from man to man, and is pulled to keep the rhino away from the corner.

With the mechanics of rhino darting at a highly developed stage, the rescue of Kenya's black rhinoceros population, and the stocking of the national parks with the animals now depends on money available for the program.

The helicopter is a vital and costly element. There are only two suitable for the job available in Kenya and these cost $85 an hour to hire, if and when the aircraft are available. The Game Department and the Kenya Government have little money to spare for this work. The capture unit has been functioning by courtesy of the East African Wildlife Society which buys the helicopter's flying time for this unit. This organization also paid about $1,500 for the unit's rhino pens.

The helicopter flew about three hours a day in the Darajani operation. The unit rescued three rhinos a day — an average of $85 per rhino in flying time, a small price for the preservation of a magnificent species.

A half dose of the antidote for the M99 drug is injected into a vein in the rhino's ear shortly after the animal is darted. The remainder of the antidote is administered after the rhino is penned in camp.

Removed from the field, drugged rhinos are placed in these pens built by the capture unit before going into the bush. Rhinos usually awaken after a "sleep" of about three hours. Rhinos are rested before release.

FAMILY LIFE OF THE

GOLDEN-NAPED WOODPECKER

By ALEXANDER F. SKUTCH

For studying hole-nesting birds, there is no place like a new clearing in the tropical forest. Thirty years ago, while the Pacific slope of southern Coasta Rica was still a wilderness of heavy rain forest broken by scattered small settlements, I spent countless hours watching the birds in such a clearing, high on a ridge overlooking a broad mountain torrent. To save work while preparing the cornfield, the axeman had left a few larger trees standing in the midst of desolation. Now, killed by the fire that had raged through the prostrate woodland, they stood, charred and gaunt, high above the dense weedy growth that sprang up after the maize was harvested. Woodpeckers of six species carved their holes in the decaying trunks. Toucans, tityras, martins, and other hole-nesters unable to carve, watched eargerly for a chance to seize the cavities made by the industrious woodpeckers.

In December, when the wet season passed into the dry and the weedy clearing was bright with flowers, I found a pair of big lineated woodpeckers digging a nest cavity high in one of these dead trees. While studying these woodpeckers with flaming crests, I learned that a much smaller woodpecker, a kind new to me, slept in an old, weathered hole above their unfinished one. At dawn, one of the big woodpeckers arrived, clung to the trunk below the new hole, and cautiously peered into it from every angle, to make sure that no snake or other animal had intruded there. Then it drummed a loud tattoo which brought its mate from the neighboring forest. Next it climbed up towards the hole from which the smaller woodpecker was looking out at the brightening landscape. The smaller bird at first drew into her bedroom, but as her neighbor continued to approach, she slipped out and fled. The big woodpecker chased the little one, nimbly dodging, from tree to tree, until at last

she took refuge in the forest. Here I found her breakfasting on the fruit of a tree with glossy leaves.

The strange woodpecker was largely black on the upper parts, wings, tail, and sides of the head. A wide white band extended down the middle of the back and broadened over the rump. The throat and breast were yellowish gray; the abdomen was scarlet; and the sides of the body were irregularly barred with black and white. The top of the head and the nape were yellow, with a transverse band of black on the crown. This was the mark of the female; males are similar in plumage, except that the top of the head is bright red, leaving only the forehead and nape golden-yellow. Months later, when I could visit a museum, I learned that this beautiful bird is called the golden-naped woodpecker (*Tripsurus chrysauchen*), and that it is restricted to the Pacific side of southern Costa Rica and the adjacent part of Panama.

At the end of the dry month of February, when the early brood of the lineated woodpecker had flown, I found a pair of golden-napes sleeping together in an old, weathered hole in the top of a branchless trunk at the head of the same clearing. This was an exciting discovery because most adult woodpeckers lodge alone, the male in one cavity and his mate in another. These golden-napes were excavating a new hole lower in the barkless trunk where they slept. Male and female shared rather equally the task of carving into the hard wood. Their spells of work rarely exceeded half an hour. When one tired of the task, it stuck its head through the round doorway and called its partner with a resonant *churr*. The mate, foraging at a distance, often responded promptly to the summons to take over the work. At intervals the tapping inside the trunk ceased, and the carver stuck its head through the doorway to release a billful of fine wood particles, which looked like powdered gold as they drifted downward in the bright morning sunshine. Other billfuls followed, once 48 in succession.

After the new hole was large enough, the mated pair slept in it. By the last week of March, I nearly always found the cavity occupied, evidence that they were incubating, although I could not reach the high nest to see the eggs. The two partners replaced each other frequently; at this and other nests of golden-napes I never saw one continue incubation for more than 51 minutes in the daytime. Other woodpeckers, including some smaller than the golden-nape, may sit uninterruptedly for hours. Probably the golden-napes' frequent change-overs are a consequence of their strong attachment to their home, which brings the free partner back to it after a short absence.

By April 7, when the dry season was ending, the parent golden-napes were carrying food into their high hole. Although years passed before I found an accessible nest in which I could examine the nestlings, I had no doubt that the newly hatched young were – like other woodpeckers – weak and sightless, with pink skin quite devoid of natal down, lower mandible longer and broader than the upper mandible, and heels covered by a callous pad studded with little projections, to prevent ab-

rasion on their nursery's unlined wooden floor. The parents carried the food, consisting of both insects and fruit, visibly in their bills, instead of regurgitating it in the manner of lineated woodpeckers, flickers, and certain other members of the family. They brought meals much more frequently than do woodpeckers that regurgitate. In the early morning, their nestlings might receive as many as ten meals in a half-hour.

At intervals the parents emerged from the hole with heaping billfuls of waste, which they usually carried to a distant tree before dropping it. In this pair, both parents attended to the sanitation of the nest, but in another pair I saw only the male perform this duty. Among woodpeckers, he is often the more domestic member of the pair.

Both parents continued to sleep with the nestlings, as they had done with eggs. Usually the female left at daybreak a few minutes before her mate; more rarely they emerged together. The nestlings were no less than 25 days old before they could climb up the foot-high wooden wall of their nursery and look through their lofty doorway. They were well feathered, with red crowns like their father. On May 10 I first saw one clinging to the outside of the trunk, near the doorway, through which another youngster was gazing. Soon the one outside climbed back into the sheltering hole.

On the following day I waited long without seeing a head in the doorway. Looking around, I found the golden-nape family high among the trees at the forest's edge. With the parents were three male fledglings who could already fly for considerable distances, although not so swiftly and confidently as their parents. Their call was a weaker version of the adult's vibrant *krrr*. They had left the nest 34 days after I first saw the parents carry in food, when they might already have been a few days old. At a number of other nests, some of which I could look into, the nestling period of the golden-naped woodpecker varied from 33 to 37 days. In their first plumage, the young resemble their parent of the same sex. Of 32 young raised in 13 nests, 20 were red-crowned males and only 12 black-crowned females.

Each evening found the whole family, parents and young together, safetly ensconced within the soild wooden walls of their lofty home. During their first days abroad, the three young woodpeckers retired early. Sometimes I found them all inside soon after three o'clock, even if no rain fell, as it so often did on those May afternoons. But they had no fixed time for going to rest, and sometimes one would delay in the open long after his brothers had entered the hole. If there was no shower, their homecoming seemed to depend upon how soon they tired of climbing over the trees.

Even on the first day when I noticed these young woodpeckers at a distance from the home trunk, one of them found his way home without parental guidance. At other nests, however, the adults led the fledglings back, after their first long outing.

Golden-nape parents differ greatly in the care they take to keep their fledglings dry. I have known families in which, when rain fell hard,

one or both parents sought shelter in their hole, leaving their recently emerged young exposed to the downpour. Perhaps because they lived at a higher altitude, where showers were colder, my first pair was more careful to keep their young out of the rain. In this region, rain in the forenoon was rare, but once I saw the father lead one of his sons back to the hole to escape a light shower that began around seven oclock in the morning. The rest of the family stayed outside, and the lone fledgling, preferring companionship to dryness, soon came forth to join the others. In the rainy afternoons, however, the young woodpeckers regularly took shelter. If the rain was light, the parents flew through it bringing food to their young in the hole, but a heavy downpour might drive the whole family into the chamber long before dark. If the rain abated early, the parents would come out to seek food for their offspring, but if it continued to fall hard into the dusk, all would remain within from about four o'clock until the following morning, the fledglings going to sleep hungry.

One of the young males vanished before he had been out of the nest for a fortnight. In October, another young male disappeared. But the third young woodpecker continued to lodge with his parents until the following March, when they were preparing to raise another brood. He had dwelt in the parental home for ten months after he first flew.

In later years, I have followed the fortunes of other golden-nape families, finding that on the whole they behaved much as my first had done, with some interesting and instructive variations. Although when I first arrived in the valley of El General I found golden-napes nesting only in the forest or near its edge, with increasing human settlement and deforestation they adapted to the changed conditions and ventured farther from the heavy woodland. My longest association was with a pair, or succession of pairs, which for seven years resided in a small coffee plantation on our farm at El Quizarrá. They became regular attendants at the feeder beside the house, sharing bananas and plantains with a colorful crowd of tanagers, honeycreepers, finches, orioles, and barbets.

This pair carved their holes in the old, dying *Inga* trees that shaded the coffee bushes. As the higher branches decayed and broke off, the woodpeckers made their holes lower, until at last I had nests that I could reach with a long ladder. The lowest in which eggs were laid was only 17½ feet up. My earlier golden-nape nests, in dead trees of the original forest, were inaccessibly situated from 40 to 100 or more feet high.

At these lower nests, I learned that golden-napes lay sets of four eggs about as often as they lay three, although I have never known them to raise more than three nestlings. These eggs, which have the lovely, glossy, pure white shells typical of woodpeckers, are laid early in the morning, on consecutive days, and they hatch after 12 days, or a little less, of incubation. Thus the nestling period is three times as long as the incubation period, which is unusual among small birds.

One year the golden-napes in the coffee plantation had an exceptionally shallow hole, only about eight inches deep, with the bottom a narrow oblong instead of rounded. It had been carved rather hastily in a dying avocado tree whose wood seemed hard for the woodpeckers. Although by day the two parents shared incubation in the normal way, at night they separated, the male attending the eggs while the female slept alone in a hole higher in the same tree. This was most unusual for golden-napes, who prefer to sleep together at all seasons, but in the majority of woodpeckers for which we have information, the male alone stays with the eggs and nestlings through the night.

A few days after the eggs hatched in this low nest, the nestlings vanished. The parents then carved another hole higher in the same trunk and hatched another brood, which also disappeared within ten days. The bereaved parents then acted most strangely. Again and again they took food into the desolated nest. After a little they would appear in the doorway still holding the food, then take it down inside once more. They might do so three times in succession, before they finally ate what they held. The male would stay in the nest for minutes together, as though brooding. This went on for at least six days after the nestlings vanished. I have known birds of other kinds, including trogons, vireos, and tanagers, to continue to bring food to a nest from which they had lost young, but never for so long as these woodpeckers. They seemed unable to accept the reality of their loss.

Even when their last year's nest hole came through the long wet season in fairly sound state, the parents moved into a newly carved one as the next breeding season approached. Frequently the young hatched in April or May remained with their parents until the following March or April, when the latter were about to resume breeding. Usually these young birds continued to sleep in their old home when, two or three weeks before the female began to lay, the parents moved into the neighboring new cavity; but one young male followed his parents to the new chamber and roosted with them until laying began. In any case, the last of the previous year's brood always vanished from the vicinity before incubation started. I do not know what sends the yearlings off at this season. Sometimes I have noticed antagonism toward them on the part of the parents, especially the father, but it has never been violent. Possibly the young depart spontaneously. I doubt whether these woodpeckers, still without territories or mates in March or early April when the breeding season begins, will nest in this same year. Probably they do not become sexually mature until the following year.

Here in El General, golden-naped woodpeckers usually raise only one brood a year, but twice the pair in the coffee plantation undertook to produce second broods. The first time that this occurred, they had raised a single female fledgling, who slept with her two parents while they incubated their second set of eggs. This nest was prematurely destroyed, apparently by ants. Three years later, the pair of woodpeckers brought forth three female fledglings on May 3. This was the earliest brood that I have recorded, and the only one consisting of three females. Although I noticed mild antagonism on the part of the father,

these juveniles were permitted to occupy the second nest while it held eggs and nestlings.

As far as I could learn, these three young females took no share in incubating the second set of eggs, with which they were so closely associated, but they were definitely interested in the nestlings that hatched from these eggs. On the first morning when I saw the parents carrying in food for the newly hatched young, one of these adolescents tried repeatedly to enter with her brooding mother, only to be repulsed at the doorway. Later, while her father was brooding, she went inside without visible opposition. Possibly he pecked her within the hole, for presently he appeared in the doorway with a downy feather sticking to his bill. It adhered so stubbornly that he climbed out to remove it, leaving his daughter within, perhaps brooding the nestlings. Later this woodpecker or one of her sisters stayed in the cavity for a long while to the parents' great annoyance. How I wished for a window in the wall of the high nest chamber so that I might see what was happening inside!

During the nestlings' final week in the hole, their elder sisters from time to time brought food to them. At least two of the adolescents, now nearly four months old, were so engaged, and probably all three were. Instead of encouraging their young helpers, the parents, particularly the mother, sometimes chased them mildly, but often she made no hostile move when she saw them approaching the nest.

These woodpeckers are not the only juvenile birds that I have known to attend siblings a few months younger than themselves. I have watched groove-billed anis, tropical house wrens, and golden-masked tanagers feed their parents' second brood. Other naturalists have recorded such precocious parental activity in birds as various as gallinules, pigeons, swallows, bluebirds, and cardinals.

Of other woodpeckers, the olivaceous piculets, among the smallest of birds, have a close-knit family life similar to that of the golden-napes. Far more widespread is the pattern exemplified by the red-crowned woodpecker, a species of *Centurus* with black and white barred plumage like that of the closely related red-bellied and golden-fronted woodpeckers of the United States. Red-crowned woodpeckers often nest in the same clearing with the golden-napes, sometimes in the same tree, but they differ greatly in temperament and habits. Adults sleep singly not only in the breeding nest but throughout the year. The male, who is the more industrious hole-carver, often has a better dormitory than the female, who is sometimes content to occupy a dilapidated one that he has abandoned. His sounder hole is often chosen for breeding, and he continues to occupy it nightly while he incubates the eggs and broods the nestlings. When, at the age of about a month, the young begin to fly, they are not led back to sleep in the nest, as are fledgling golden-napes. Quite the contrary, if, as night approaches, they try to join one of their parents in its dormitory, they are firmly repulsed; if they steal a march on a parent and enter its hole first, they are unceremoniously evicted. They must roost clinging to a trunk in the open until they can find an unoccupied hole, or carve one for themselves. What a contrast between the Spartan treatment of red-crowned fledglings and the solicitous care that young golden-napes receive!

ARGENTINE FAUNA:

FROM ITS JUNGLED NORTH, jutting toward South America's midsection, to the chill dead end of the continent at Tierra del Fuego, Argentina is a land of environmental contrast. Few countries in the world exceed it in variety of habitats.

Argentina's northernmost tip is transected by the Tropic of Capricorn. There the jaguar and ocelot roam a wilderness of subtropical forest, home also of the tapir, the peccary, two species of anteater, toucans, caciques, and several species of parrots. In the more open savanna country of the Chaco live the maned wolf (*Chrysocyon brachyurus*), and the giant armadillo (*Priodontes giganteus*). Elsewhere, in the northern lowlands, caimans and piranhas share the same waters.

No more than ten percent of Argentine territory, however, is sub-tropical. Argentina is above all the land of the pampas: of wheat fields sprawling almost without end, vast herds of cattle driven by sturdy riders — the gauchos, and fields of corn, all rooted in the black rich soil. These are the pampas of man.

Hunters have relentlessly pursued the guanaco into its last retreat, the sparsely-populated Patagonia. This New World representative of the camel family once ranged over vast areas of the Argentine pampas.

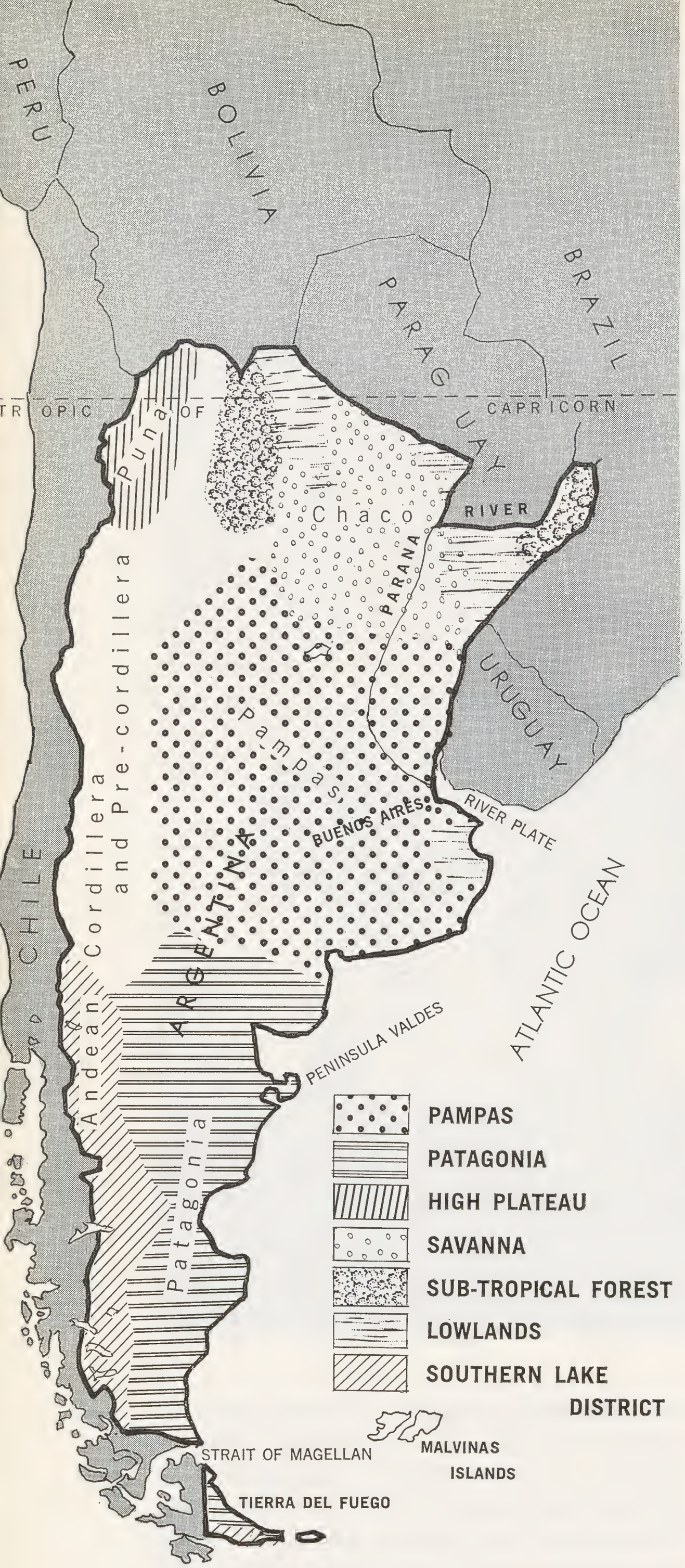
OF DECISION

By FERNANDO NOTTEBOHM

The true pampas are the land of rheas and tinamous, of the burrowing owl (*Speotyto cunicularia*), of guanacos (*Lama guanicoe*) and pampas deer (*Ozotoceros bezoarticus*), and until recently of pumas and jaguars. Above this treeless expanse wheel the southern screamer (*Chauna torquata*), the tero or spur-winged lapwing (*Vanellus cayannensis*), and the carancho, or cara cara (*Polyborus plancus*).

Pampas marshes are alive with herons and ibises, with coots, grebes, ducks and geese, and with that incredibly beautiful bird, the black-necked swan. The capybara, largest of rodents, and two kinds of river otters slosh through the waters of the Paraná River basin. Lowlands on both sides of the river are the haunts of the marsh deer, or guazuncho.

There are yet other faces to Argentina's faunal picture: that of the Andean high plateau or "puna"; in the country's northwestern corner; the domain of lakes and glaciers in the southern reaches of the Andes; the wind-beaten Patagonia, home of Darwin's rhea, the

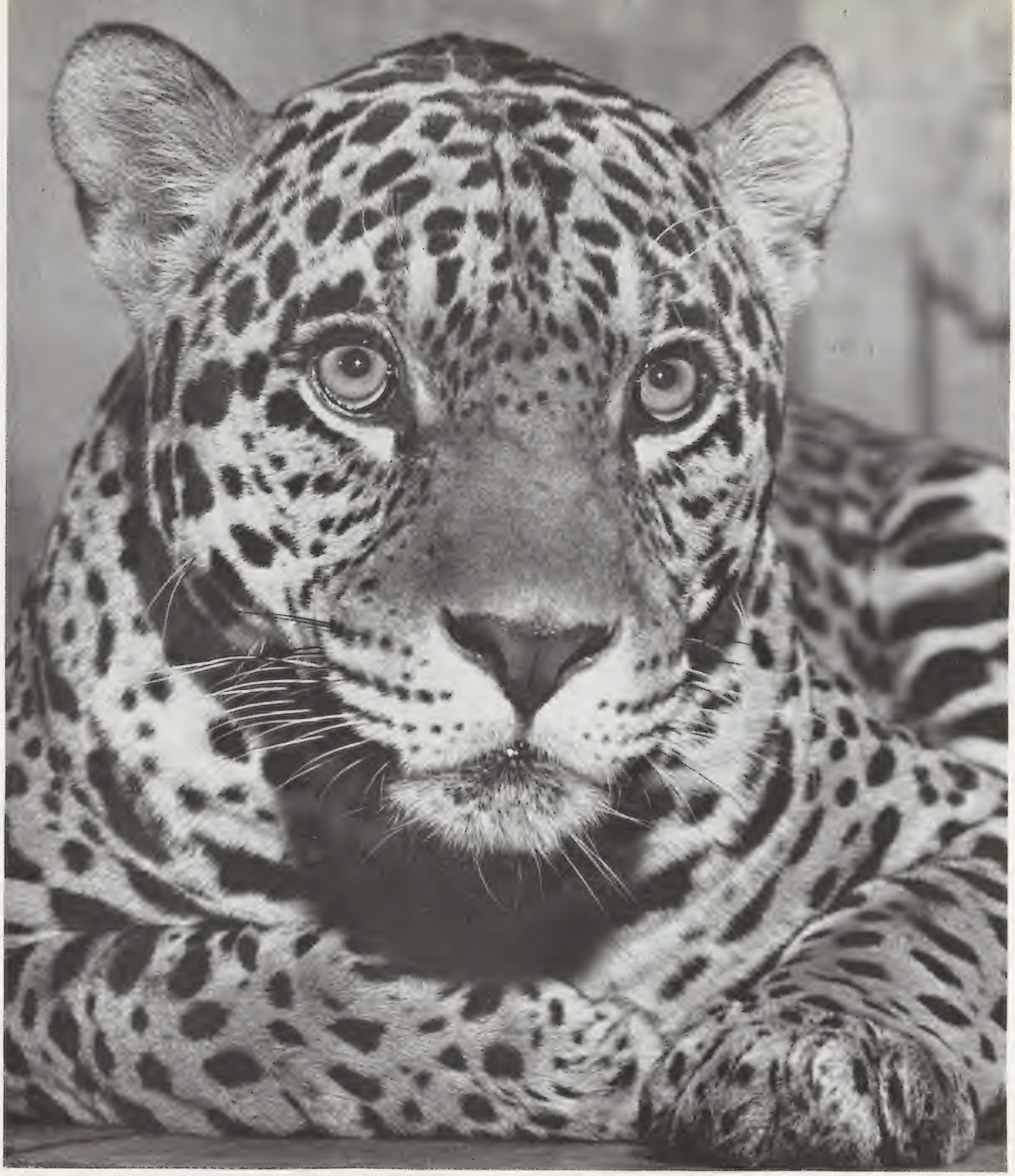


Hunted with dogs, tapirs (above) have become rare in Argentina's subtropical jungles. The capybara (above right) is the largest living rodent; hides of this expert swimmer have been exported by the hundreds-of thousands. The giant armadillo is now virtually extinct in Argentina; here it shares a meal with its smaller relative, the six-banded armadillo. Safaris, officially sponsored, have lured "sportsmen" to the last retreats of this irreplaceable living fossil.

(*Pterocnemia pennata*) Patagonian cavy (*Dolichotis australis*), and of guanacos; and finally by the Atlantic coast with its rookeries of Magellanic penguins (*Spheniscus magellanicus*), seals, sea lions, and sea elephants.

Unfortunately, this very same fauna is undergoing a crisis. The unnecessary destruction and wastage of habitat, and a continuously advancing subdivision and colonization of the land threaten to wipe out many of the most typical Argentine species. Recent times have also brought pollution of the environment which accompanies modern agriculture, and an expanding population of hunters. As if these pressures were not enough, the introduction of foreign game animals has upset the ecological balance in many areas. In some districts for instance, the European red deer (*Cervus elaphus*) and the European wild boar (*Sus scrofa*) have been introduced and are now multiplying quite out of control. Another introduced species, the European hare (*Lepus europeus*), has displaced the Patagonian cavy from the better part of its original range.

The punishment received by Argentina's wildlife has been tremendous. A few figures on the export of hides between 1940 and 1960 will be found revealing: capybaras, 450,000; ocelots, 8,800; rheas, 199,000; peccaries, 488,000; vizcachas, 4,825,000; caimans, 105,000; sea elephants, 28,926. The figures do not include amounts consumed by the internal market.



Furthermore, the number of animals that have been declared "pests" verges on the absurd. The list includes three out of five species of geese, 14 out of 34 kinds of parrots, two species of peccary, the jaguar, and even the condor. As a matter of fact, the total number of species considered "pests" is astronomical: 63 mammals, 38 birds, 13 reptiles — a most unsympathetic an uncompromising approach to any native fauna.

The methods used to combat some of these "pests" are deplorably ingenious. In a campaign aimed at eradicating a colonial parakeet, the "cata común" or "cotorra" (*Myopsitta monacha*), the authorities recommended use of incendiary cartridges to set the nests ablaze during the breeding period. Even acknowledging the harm this species does to agriculture this procedure would seem a bit cavalier.

At the same time, however, Argentinian governments in the past have not been completely oblivious to the need for conservation. The Argentine National Park System was created in 1934. At the present time this system includes some 13 national parks and covers over 6 million acres.

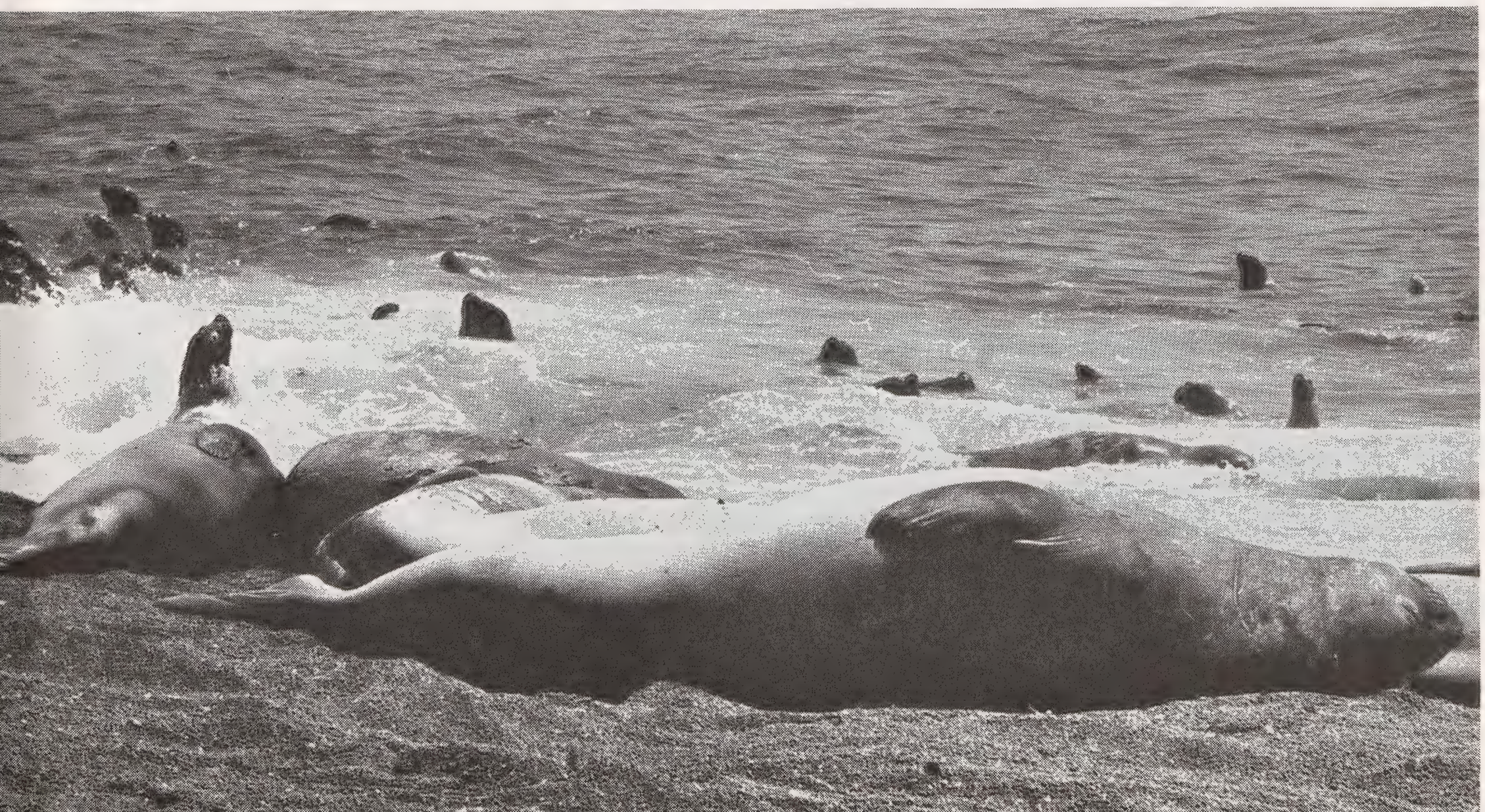
Unfortunately in some parks part of the land is used by squatters, and the park en-

vironment is not always free from abuse and illegal hunting. Hunting regulations exist in theory, but undoubtedly a good number of hunters are not bothered by them. A case in point is that of the crested tinamou, or martineta. This species, one of the most coveted game birds, has become rare in its pampas habitat, where it once abounded.

The best evidence of the very limited protection enjoyed by Argentina's wildlife, however, is found in the growing number of species which are becoming increasingly rare. Among those whose disappearance from that country's territory is imminent we can list the giant armadillo, the pampas deer, the dwarf deer (*Pudu pudu*), the huemul (*Hippocamelus bisulcus*), the maned wolf, and the Patagonian cavy or mara. The distribution of at least 20 other mammalian species is under continuous regression.

Against the background of this needless destruction of a rich, original, and beautiful fauna comes the creation, early this year, of the "Comité Argentino de Conservación de la Naturaleza" (C.A.C.N.). Its president, Milán Dimitri, has for many years pleaded for the protection of Argentina's vanishing flora and fauna. Within the framework of the National Park System he has gleaned abundant experience as director of the Nature Protection Department. The new committee headed by Dimitri is a private undertaking. It includes

Argentinians view the jaguar as trophy or pest; the need for protecting it has passed unnoticed. Sea elephants and Patagonian sealions, brutally exploited in the past, have found precarious haven on Punta Norte's beaches. Unless permanently protected, where they breed today they may be slaughtered tomorrow. The diet of the Patagonian grey fox consists largely of rodents; thus it plays an important role in the balance of nature. The usefulness of the fox has not been recognized. The fox is systematically destroyed.



well known personalities of the local academic community as well as many amateur naturalists. One of its first tasks will be to survey the populations of many of the endangered species, to study their ecology, and to select areas suitable for their protection.

Through publications, films, and conferences the new committee intends to propagate conservationist ideals and practices.

In the past, trained biologists have had no say in attempts to safeguard the native flora and fauna. Parks were set up without a clear notion of what exactly should be protected, often preserving little else than scenic beauty. Evaluations of minimal habitat requirements for year-round breeding populations of the more endangered species were not made. It was not understood that human disturbance within parks must be kept to a minimum for the protection of species and habitats. Furthermore, no concerted effort was made to preserve representative samples of the different kinds of habitat to be found within the nation's boundaries. It is the manifest purpose of the C.A.C.N. to produce studies covering all these aspects, and to influence private and governmental actions accordingly.

Some of the committee's initial projects are exciting. One of them considers the creation of sanctuaries to protect the seals, sea lions, and sea elephants of the Atlantic coast. One possible area has already been selected in the Peninsula Valdez. Punta Norte on that peninsula is probably the only "elefantería" remaining on the South American continent. Also considered is the creation of sanctuaries where representative samples of the pampas environment will be preserved intact, and where even some of the innumerable "pests" and game species will find their right to live unchallenged by man.

Will this enterprise succeed? Will it find enough understanding and support among the Argentine people and government? Indeed, will it find enough support and understanding from the worldwide community of conservationists? Time will tell.

Cattle and rheas mix on Argentina's flat, treeless pampas, home of that storied South American cowboy, the gaucho. There is room for both cattle ranching and wildlife on these vast South American plains.

ANIMAL KINGDOM REPORTS . . .

NEWS OF ZOOS, AQUARIUMS AND CONSERVATION

MAMMAL HATCHES

AN EGG-LAYING MAMMAL — the very statement seems a contradiction. Yet the monotremes, a primitive order of mammals including the platypus and the echidnas, or spiny anteaters, do lay eggs — a method of reproduction that appears a relic of some distant yesterday in mammalian evolution.

Because of this unique — among mammals, at any rate — method of reproduction, the breeding of a monotreme in a zoo is an extra-special event. And it is an occurance as rare as it is special. So when the Basel Zoo in Switzerland reported the birth of a young echidna, zoo men around the world took notice. For the full story on Basel's echidna birth, Animal Kingdom *presents a report from Dr. Ernst M. Lang, director of the Swiss zoo. "We keep two echidnas, a male imported in 1949 and a female imported in 1953. The animals differ considerably, especially in the length of their spines, those of the female being much longer. In 1955 we discovered a baby which we tried to return to the female's pouch. The next day, however, it was found dead. This spring, on March 23, to be exact, one of our keepers observed a baby hanging out of the mother's pouch, but the youngster disappeared immediately afterwards. On March 25 the baby was seen again in the afternoon, but it was taken back into the pouch shortly afterwards. Its weight was 170 g. and it was a deep grey in color.*

"During the next few days we saw it from time to time, either lying somewhere in the cage or climbing back into its mother's pouch. When the mother was carrying the baby in the pouch, her whole belly hung down to the ground.

"On April 3 and April 4 the baby was again in the pouch, but the next day the mother refused it and we were obliged to feed it on tinned milk. The baby ate about 20 g. out of

Birth of an echidna at the Basel Zoo drew worldwide notice. The baby was maintained for almost a month.

the palm of my hand every day. On the morning of April 9 the baby was back in its mother's pouch, but from time to time she refused to accept it. On April 13 it was seen in the mother's pouch for the last time. Afterwards she showed no more interest in the baby. We fed it regularly, but the animal's digestion was apparently not in order. On April 17 we found it dead.

"It was very interesting to observe how the baby sucked milk out of the palm of my hand by rubbing the skin with its beak and sucking the milk in regular draughts."

KANGAROO SLAUGHTER

KANGAROOS — a half-decade ago these familiar marsupials swarmed through Australia's outback, thronging in vast "mobs" through isolated sheep stations and even venturing into suburbs of some towns. Last year, however, a scientific party journeyed 3,000 miles north from Melbourne to the Gulf of Carpentaria and spotted less than a dozen live kangaroos. This sparse number of sightings was grim evidence of what conservationists view with increasing alarm — the danger of kangaroos joining the ever-increasing numbers of endangered species.

The reason behind the sudden fading of the Island Continent's kangaroo population? Mass slaughter by hunters armed with weapons that would do credit to combat troops. Kangaroos have been cut down by automatic weapons — some say even by machine guns.

Much of the meat from slaughtered kangaroos suddenly turned up on the world-wide market. More than 10 million pounds of kangaroo meat was exported from Australia in 1965. Millions of pounds more were consumed in the country itself.

Kangaroo meat not destined for human consumption is turned into dog food, thus increasing the profits that lure hunters to the kangaroo slaughter. Killing of the animals for their hides has also become an avocation in the outback.

As the profits multiply, so do the numbers of hunters who mowed down the animals. Meanwhile, like the follow-up on a one-two punch, drought has gripped large areas over which kangaroos roam. Studies indicate that the number of kangaroos drops sharply when prolonged dry spells hit their range.

CAUGHT IN THE ACT

IN THE COURSE OF A YEAR, the barn owl manages to catch hundreds of field mice to feed itself and its young. This is a remarkable feat; considering the secretive habits of mice and the darkness of most nights. The question of how the owl manages to catch enough mice to survive has occupied the research efforts of Dr. Roger Payne for a decade. Dr. Payne is now assistant professor and research zoologist with the Institute for Research in Animal Behavior, the New York Zoological Society's joint venture with Rockefeller University.

Dr. Payne has demonstrated in previous studies that the barn owl can successfully strike a mouse in total darkness from distances up to 20 feet by listening to rustling sounds made by the mouse. But many questions remain unanswered. The accompanying picture is a multiple flash photograph on infra-red sensitive film of a barn owl striking a mouse in total darkness. Because infra-red was the only

illumination present when the picture was taken, neither the owl nor the person watching could see anything. (Both owls and people are insensitive to infra-red light.) By use of such photographs and sniperscopes which allow the human eye to see objects lit only by infra-red light, Dr. Payne and his assistant, Miss Victoria Rowntree are observing five barn owls, recently brought from Texas, as

the birds learn to feed in captivity. When the owls become accustomed to their surroundings, new experiments will be carried out to explore such questions as the ability of the owl to estimate the distance to a sound source.

LONGEVITY RECORD

A HERRING GULL, found dead by a group of Girl Scouts on a Lake Michigan shore 36 years after it was banded by a young ornithologist on the Maine coast, is believed to have set a new world record for longevity in a wild bird.

Olin S. Pettingill Jr., director of the Laboratory of Ornithology at Cornell University and the man who banded the herring gull on June 29, 1930, has reported the finding of the dead bird.

Pettingill recalled going ashore at Duck Rock, an islet just off Monhegan Island, Maine, on the June day in 1930. He and three companions spent an hour on the rock and during that time he banded 19 herring gulls, then only ten-day-old chicks.

The troop of Girl Scouts chanced upon the dead bird recently on the shore of Lake Michigan's Little Traverse Bay, near Petoskey in northern lower Michigan. When they noticed a copper band bearing a number on the gull's leg — urging them to "Notify Biological Survey, Washington, D. C." — the girls cut off the tag and the troop leader mailed it as directed. Eventually word of the find reached Pettingill and the internationally-known laboratory at Cornell.

"The fact that this bird had moved far inland from its coastal birthplace is noteworthy," Pettingill said, "and the fact that it died within a few miles of the University of Michigan Biological Station where I was teaching in 1930 is a curious coincidence, but hardly extraordinary. What is extraordinary about the report is that the herring gull had lived 36 years."

The nearest life-span record in a wild bird, as far as the Cornell laboratory knows, is that of another herring gull, in Europe, whose known age was 31 years and 11 months. The longevity of the European gull is chronicled in W. Rydzewski's The Ring, *published in 1962. How long a bird lives, ornithologists point out, depends on many things, including size. The lifespan of one curlew was recorded as 31 years and six months; a black-headed gull lived more than 30 years and wild songbirds are known to have lived as long as 16 years. In captivity, free from the hazards of life in the wild, the picture is much different. A captive eagle owl died at 68, an Andean condor at 65.*

Provocative as the tale of the Maine-to-Michigan gull is, it was the troop of Girl Scouts in the case who added a final twist to the story. When the girls were told of the importance of their discovery on the lake shore, one of them mused brightly, "Gee, do you suppose the old guy who banded that bird is still alive?"

NEW SIBERIANS

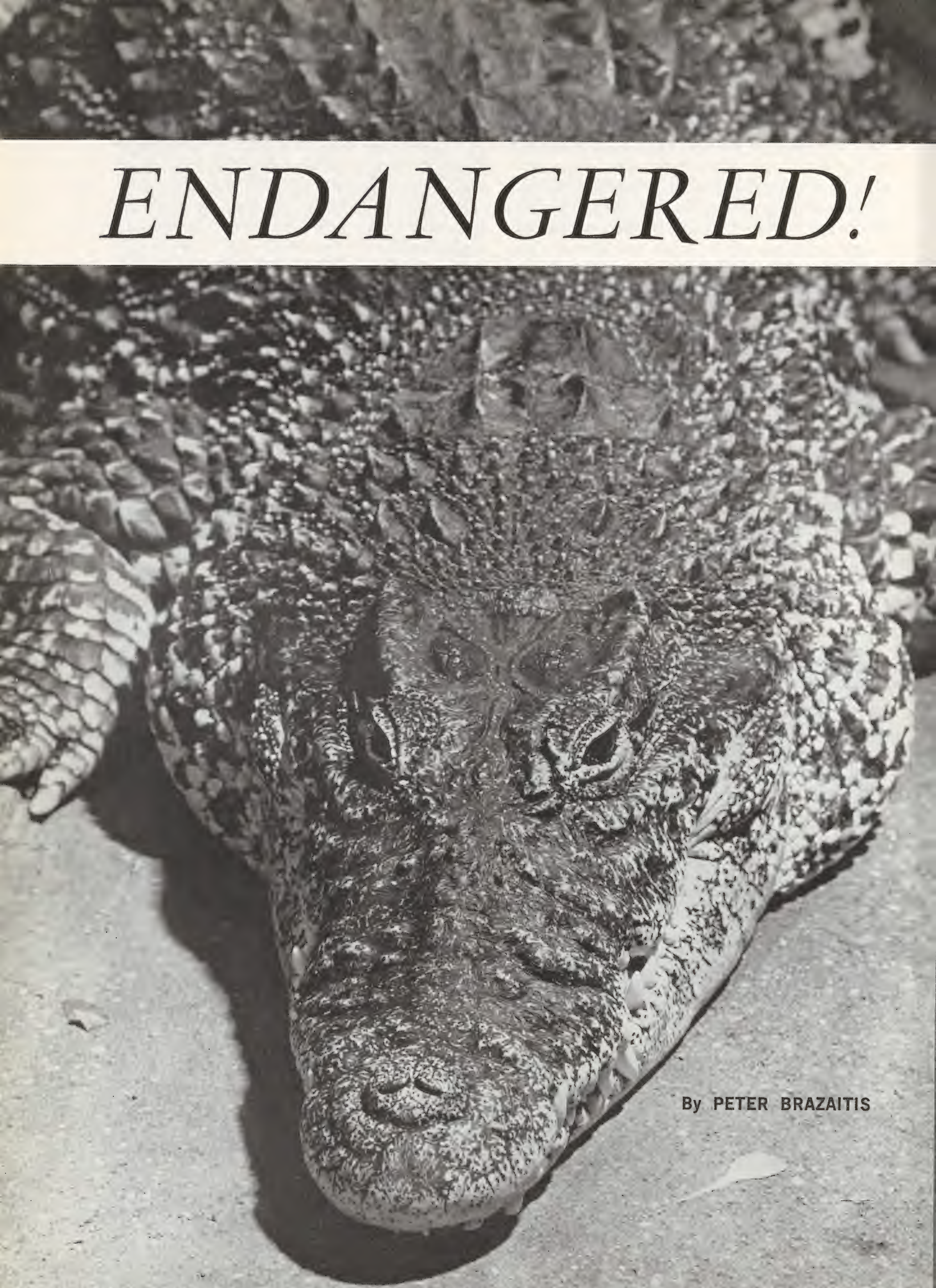
THREE NEW CUBS are the latest additions to the Bronx Zoo's collection of Siberian tigers (Panthera tigris), *bringing the Zoo's total of these great cats to six.*

The three cubs survive from a litter of four born June 15 in a dark, seven-by-seven-foot stone den at the rear of a large exhibit cage. The cubs' mother kept the youngsters in the den until early in the morning of July 3, when a surprised head keeper discovered the new family in the cage within public view.

Plump and active, the three cubs appear to be doing quite well. Their mother calmly nurses them, licks them, and corrals one youngster that seems prone to occasional wandering about the cage.

Approximately 200 Siberian tigers remain in the world, most of them in zoos. A small number still roams the Siberian wilderness.

ENDANGERED!



By PETER BRAZAITIS

Crocodilians are in trouble — worldwide trouble. Despite their fierce reputation, these reptiles are easy prey for man. The Cuban crocodile, on the opposite page, numbers less than 500 in the wild.

SKIMMING OVER THE WATER, leaving sawgrass tossing in its wake, the darkened airboat cuts through the deep Everglades night. Two men aboard the boat peer through the heavy darkness as the fleet craft whooshes by hammocks and small islands. Their destination: an alligator "wallow," nesting ground of a half dozen of the large reptiles. Their purpose: poaching — illegal killing of the alligators for their hides.

Poaching, along with swamp drainage projects, threaten the last wilderness strongholds of the American alligator (*Alligator mississipiensis*). And on a world-wide scale, similar pressures also threaten the existence of other crocodilians.

Hides of the various species of crocodilians are used to make fine leathers; and the demand for hides is such that a black market flourishes in many areas. At the same time, land reclamation projects in many parts of the world are shrinking the watery environment on which crocodilians are so highly dependent. In Florida, for example, conservationists complain that agricultural drainage programs pose a definite threat to wild alligators.

Poachers are also active in the Florida swamps. Ironically, the Florida Game and Freshwater Fish Commission has supported legislation that would permit licensed hunting of the "gators" during periods specified by the Commission.

Strongly opposed by conservationists, the bill — in the eyes of the Commission — would "curtail our present poaching situation and black marketing of hides." It is already within the Commission's power to declare open season on alligators. The Commission feels, however, that licensing would encourage legitimate hunting and discourage poaching.

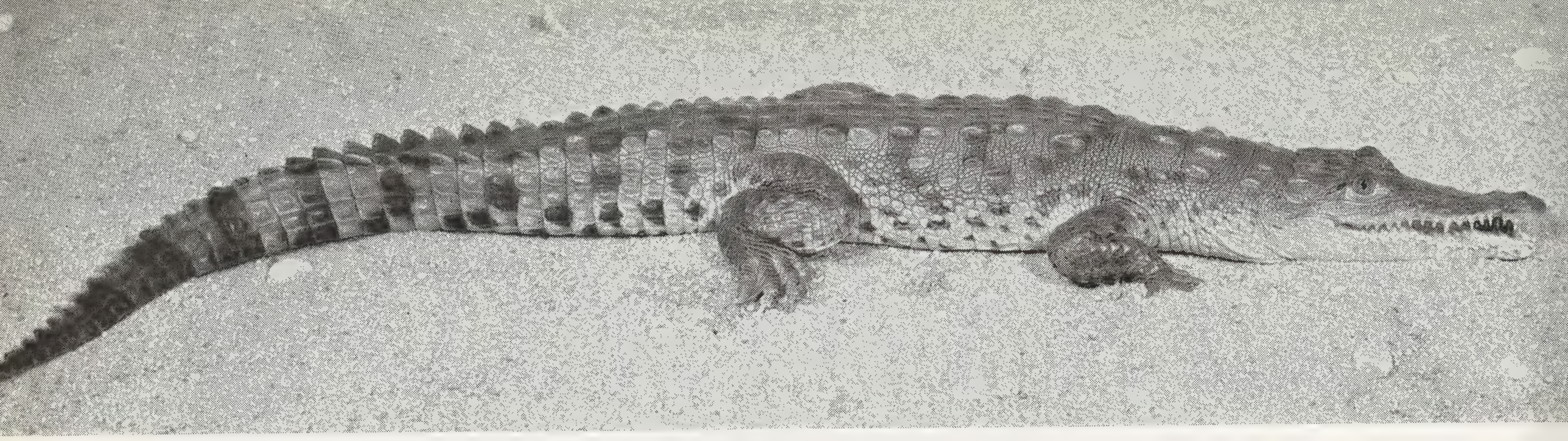
At the same time, according to a Commission spokesman, licensing fees would provide funds for support of the Commission's efforts against poaching. The spokesman noted that the Commission views the "gators" as a "renewable natural resource" that "should pay its own way." The spokesman explained that a large portion of the income from license fees paid by hunters and fishermen is now being diverted to alligator preservation activities. The bill, before the State Legislature at this writing, is expected to be killed.

Recently added to the list of "endangered species," the American alligator breeds only once a year. An average clutch of between 40 and 60 eggs is deposited by the female in a nest constructed of aquatic plants and debris.

Nest mounds may be as large as five feet high and ten feet wide. The eggs draw many predators, including raccoons, skunks, and man. During the incubation period, the female mounts careful guard over the nest. If she is removed from the nest, however, the developing eggs have almost no chance for survival.

Unfortunately, hunting of alligators and other crocodilians is usually carried on in an indiscriminate manner, with nesting females as well as males taken by hide-hunters. Once the parent is shot, the developing eggs are left at the mercy of both predators and the elements. Modern equipment and its use by professional hunters and poachers alike enable hunters to operate with deadly efficiency. Today the modern crocodile hunter often seeks out his quarry by air, with the aid of topographical maps and four-wheel-drive vehicles. He stalks the reptile at night, by boat, while the animal is out hunting food. Under the bright beam of a spotlight the reptile's eyes glow like hot coals in the darkness of the night. While seemingly transfixed, the animal is killed with a high-powered rifle or shotgun and harpooned before the body can sink below the surface. The hunter can take skins and then return for more in half the time it took ten years ago. And today the prices paid for raw hides provide a greater incentive for poaching.

The picture seems to repeat itself around the



The American crocodile (above) and the black caiman (right) are threatened—the crocodile by drainage of its habitat and the caiman by hunters. Both of the photographs shown here are of immature specimens.

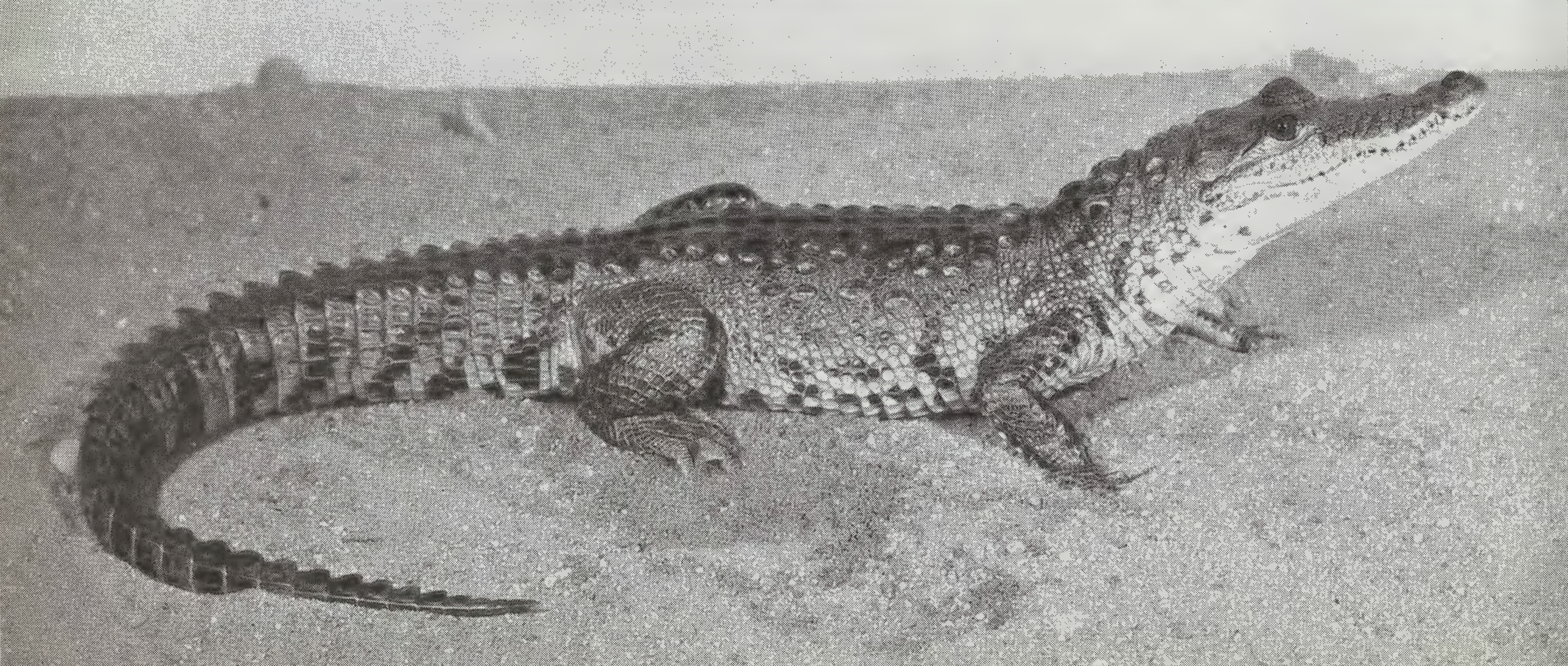
world. The Morelet's crocodile (*Crocodylus moreletii*), found in fresh water swamps and lagoons in Yucatan and British Honduras, has been so reduced in number that even professional hunters have difficulty in locating a few animals. Sixty years ago, a thousand Morelet hides were sold on the market daily in Yucatan. Today native fisherman may go months without sighting a single specimen. In 1965, however, a collector returned from Mexico with a number of juvenile animals. They are now housed at the Grant Park Zoo in Atlanta, Georgia, where they could form a breeding nucleus to rehabilitate the species.

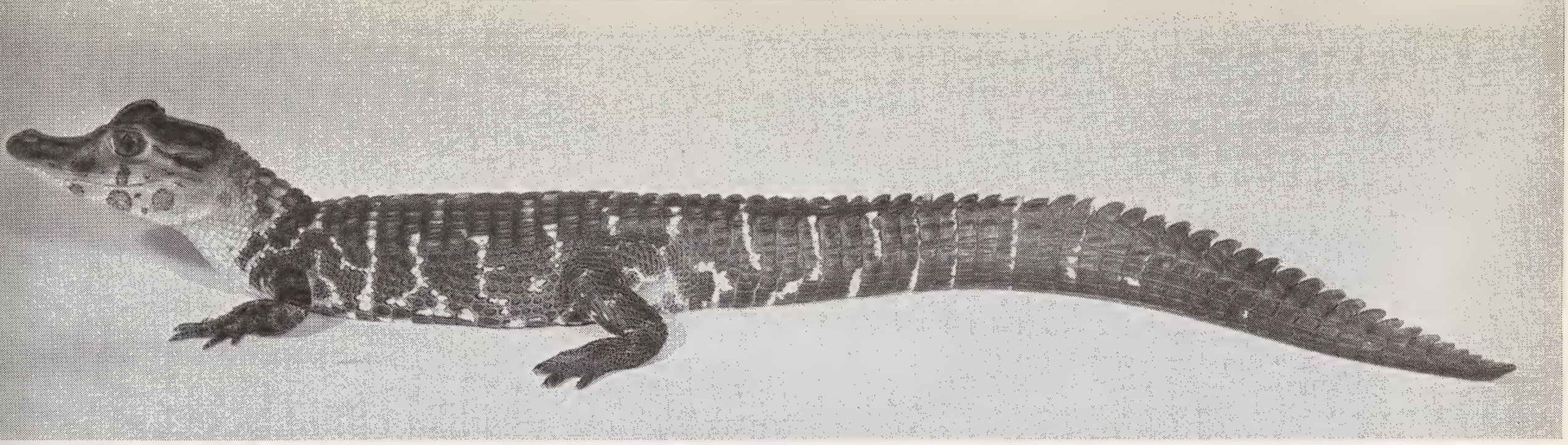
Equally in danger of ultimate extermination is the large and conspicuous black caiman (*Melanosuchus niger*) of the Amazon River. Similar in coloration to our American alligator, it often grows large enough to enable it to catch and kill cattle. At certain times of the year, when the rivers and swamps dry up, black caimans may be found congregated in great numbers in small pools, where they are hunted by cattlemen who lasso them from the saddle. Once roped, the caiman can be dragged from the water and easily killed with an axe or machete.

Elsewhere, the Nile crocodile (*Crocodylus niloticus*) is under merciless attack in its African home. This species, native to tropical Africa and Madagascar, provides a large percentage of the world's crocodile hide supply. Today, one of its last major strongholds is in northern Rhodesia — and even there it has been greatly reduced.

The position of some New World crocodiles is even more perilous. A harmless giant that sometimes reaches 23 feet in length, the American crocodile is slaughtered for its hide through most of its range. This animal lives over a wide area — from the southern tip of Florida, through the West Indies, portions of Mexico and Central America, and in Northwestern South America. If the American crocodile's south Florida habitat is further disturbed by draining operations, it may vanish from the United States.

The Cuban crocodile (*Crocodylus rhombi-*





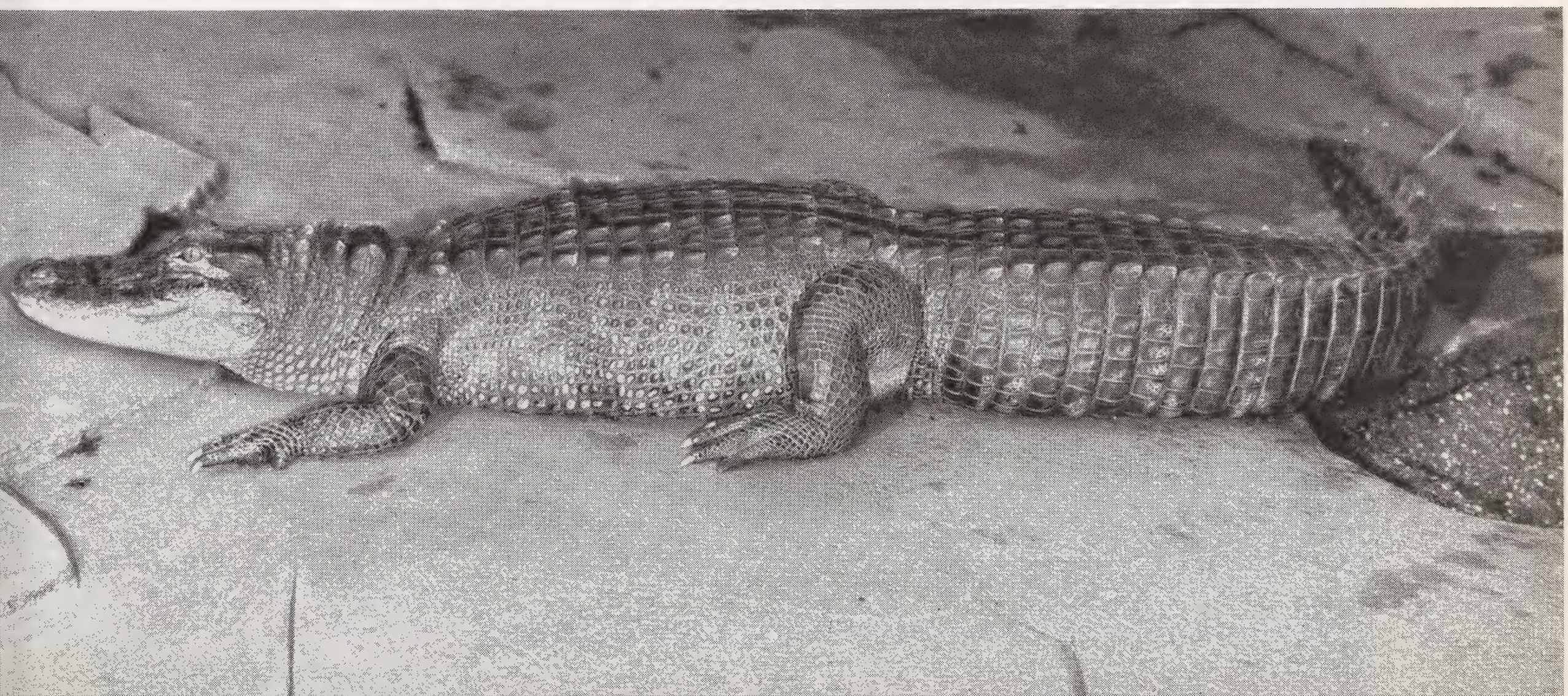
fer), found only on the coast of Cuba in the area of the great Zapata Swamp, has been in trouble for decades. Latest reports place their numbers at less than 500 in the wild, with a few more in zoos both here and abroad.

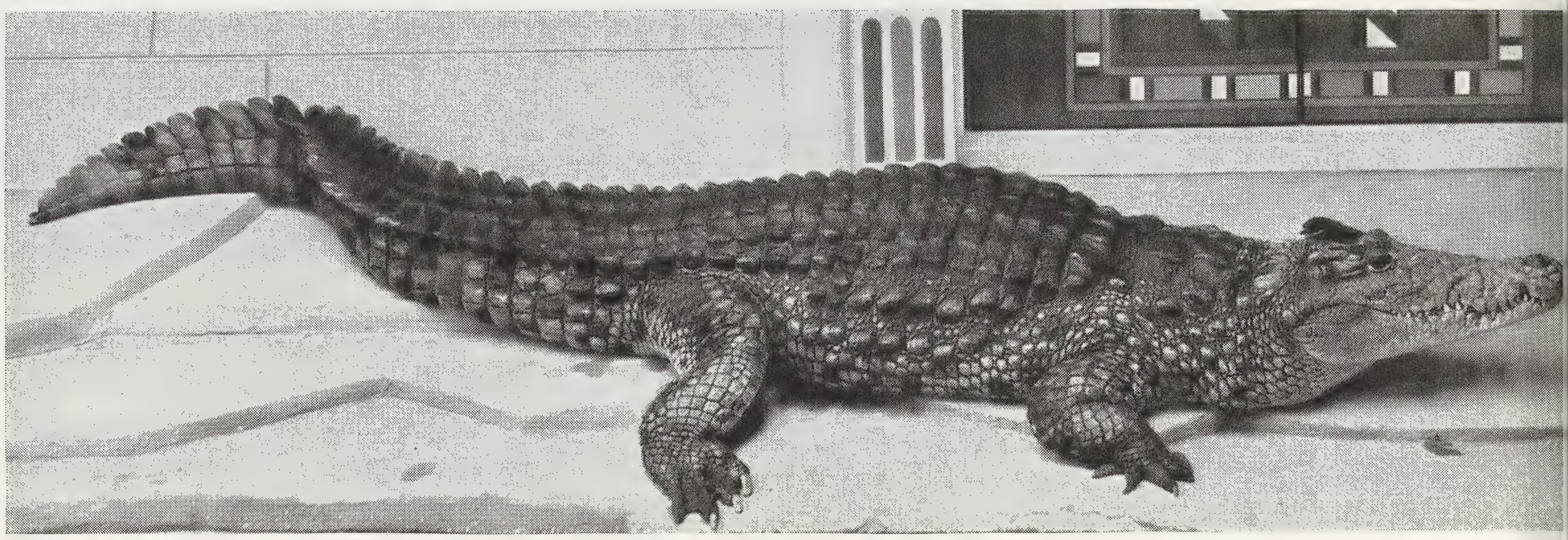
Along with hide hunting, the pet trade takes a heavy toll on some species, such as the South American caiman (*Caiman crocodilus*). Hundreds of thousands of baby caimans are imported each year and sold as pets. By the time the new owner finds that his pet requires temperatures of 85 to 95 degrees F. in order to survive, it is usually too late to save the animal from pneumonia. And even if proper temperatures are maintained the diet fed these reptile pets is in most cases deficient in calcium. In a very short time, therefore, the animal develops bone deformities as the result of rickets. Great numbers of caimans destined for pet shops are collected as eggs and are incubated until they hatch. The hatchlings are then packed and shipped by air to the wholesale dealer. One recent shipment consisting of 1000 baby animals arrived in New York City with nearly 200 dead animals. This was considered to be an average number of deaths per thousand. The remainder of this shipment had yet to be distributed to the retail outlets.

Outside of efforts to preserve the American alligator in the United States, and the Nile crocodile in a few national parks in east and South Africa, little has been done to safeguard crocodilians in their native habitats. In most instances, although laws prohibiting hunting are enacted, the machinery to enforce these laws does not exist. And it is of little value to establish a preserve if sufficient funds are not allocated to maintain an adequate force of wardens to curb poaching.

In South Africa's Mkuzi Game Preserve, however, a unique project is underway to restock the Nile crocodile in areas where it was once abundant. Eggs from the nests of wild crocodiles are collected and incubated under artificial conditions. The collected eggs are placed in boxes containing damp grass or straw. Each egg is marked upon removal from the nest to insure that it will be placed in the incubation box right side up. The eggs are

Morelet's crocodile (young individual at left) is disappearing from its native Yucatan. The American alligator (below) is the subject of ardent conservation efforts. It is hunted by poachers in Florida.





then maintained at temperatures of from 80 to 95 degrees F. If fertile, they can be expected to hatch in about 12 weeks. The young are then kept in enclosures until they are large enough to be released in areas selected for repopulation.

An attempt to breed another — and lesser known — crocodilian is underway in the New York Zoological Park. This animal is the Chinese alligator (*Alligator sinensis*). The presence in China, so far north, of a crocodilian inhabitant was first reported in 1870. The animal was not, however, described to the scientific world until nine years later. This only other member of the genus *Alligator*, to which the American alligator also belongs, is found in the lower Yangtze River in the vicinity of Wuhu and Taihu.

The Bronx Zoo's pair of adult specimens has been maintained for many years. Recently, when given quarters by themselves, the alligators showed interest in breeding. Observation of the pair indicates that the female, rather than the male, may play the most active role in courtship activities and territorial defence. Little is known of the Chinese alligator's habits in the wild or the animal's heat re-

Efforts are underway in South Africa to restock the Nile crocodile (above). Pet shops sell large numbers of young South American caimans (right). The Bronx Zoo hopes to eventually breed the rare Chinese alligator (below).

quirements. The Bronx Zoo provides its pair with two enclosures, each containing a pool of water. Water is fed into the pool through a mixing valve which can deliver selected temperatures of between 55 and 100 degrees F. Natural plantings and substrata suitable for burrowing will, we hope, provide the habitat for successful breeding.

There are other factors involved of unknown importance. In the wild the Chinese alligator hibernates during the cold dry season. When the dry season ends, the rains raise the water table and the animals begin to emerge. Breeding soon takes place and the eggs are laid almost two months later. Where or how the eggs are actually deposited is not known. Therefore the Bronx Zoo will have to consider the possibility of having to establish a yearly climatic cycle in order to trigger the animals' breeding cycle.

Although breeding projects and "farms" cannot be considered the best approach to preserving a species, they must be seriously considered in the case of those species on the brink of complete disaster. A sexing technique developed by the writer has made it possible to select individual animals as potential breeding pairs, rather than choosing a group of animals at random.

Both efforts to breed endangered crocodilians in captivity and programs to preserve them in the wild must be encouraged and developed if these reptiles are to remain part of the world's wildlife scene.

THE BOOKSHELF

THE WATCHER AT THE NEST. By Margaret Morse Nice. 159 pp., two maps and 19 drawings by Roger Tory Peterson. Dover Publications, Inc., New York, 1967. $1.50.

Dr. Nice is best known for her technical work, *Studies in the Life History of the Song Sparrow.* The present volume is written in a more popular vein and recounts some of her field observations of nesting warblers, vireos, doves and herons. The greater portion of the book, however, is devoted to the personal lives of two song sparrows, covering an eight-year period. Their courtships of a series of mates, battles to acquire and retain a territory, and the successes and failures of their nestings are all told with a charm and humor that gives a personal insight into the lives of the birds and the observer. First published in 1939, this edition in paperback has been slightly corrected but is unabridged.

J. Bell

THE MAMMALS OF EASTERN CANADA. By Randolph L. Peterson. 465 pp. Illus. Eight plates in color, 233 drawings in black and white, 107 maps and 14 tables. Oxford University Press, Toronto, 1966.

This welcome volume presents a happy combination of informal, readable text and accurate technical data. The requirements of readers at all levels are readily met with the many excellent drawings, distributional maps and tables. The author covers 234 forms, of which 213 are native to eastern Canada, extending from Newfoundland to Ontario and including adjacent islands. Many of these animals are found in nearby areas of the United States, so that the book will be useful to a much larger reading public than indicated by the title. A glossary of terms used, a lengthy bibliography and an index of technical names and both French and English vernacular terms, add much to the value of Dr. Peterson's handsome volume.

L.S.C.

BASIC MICROSCOPIC TECHNIQUES. By Ruth McClung Jones. i-xiv + 334 pp. University of Chicago Press, Chicago and London, 1966. $6.50.

This book is based on *Animal Micrology* by Michael F. Guyer, published in 1906. It is an excellent standard book for students and technicians, the usefulness of which is enhanced considerably by the addition of many new but selective procedures. R. F. N.

Letters to the Editor

Editor:

That's a very interesting article in "Animal Kingdom" on Baboons, and I thoroughly enjoyed it. I submit, however, that no Papio *(or other monkey, for that matter) would enjoy being called a* cyanocephalus *(Page 42) when he could be called* cynocephalus, *or "dog-headed". Would you agree?*

Edward Robinson
New York, New York 10023

— Our curator of mammals agrees . . . Editor

Editor:

As a new subscriber I want to tell you that the April issue was very interesting, especially the coverage of the baboon, with pictures of the entire family. It is especially enlightening to laymen who are often confronted with a group of cages containing several kinds of similar animals, and the general impression we have is "a monkey is a monkey is a monkey."

So the baboon article helps us to look at a cage with better understanding of its contents.

I am looking forward to the second and following issues.

Bob Kerr
Amarillo, Texas 79105

About the Authors

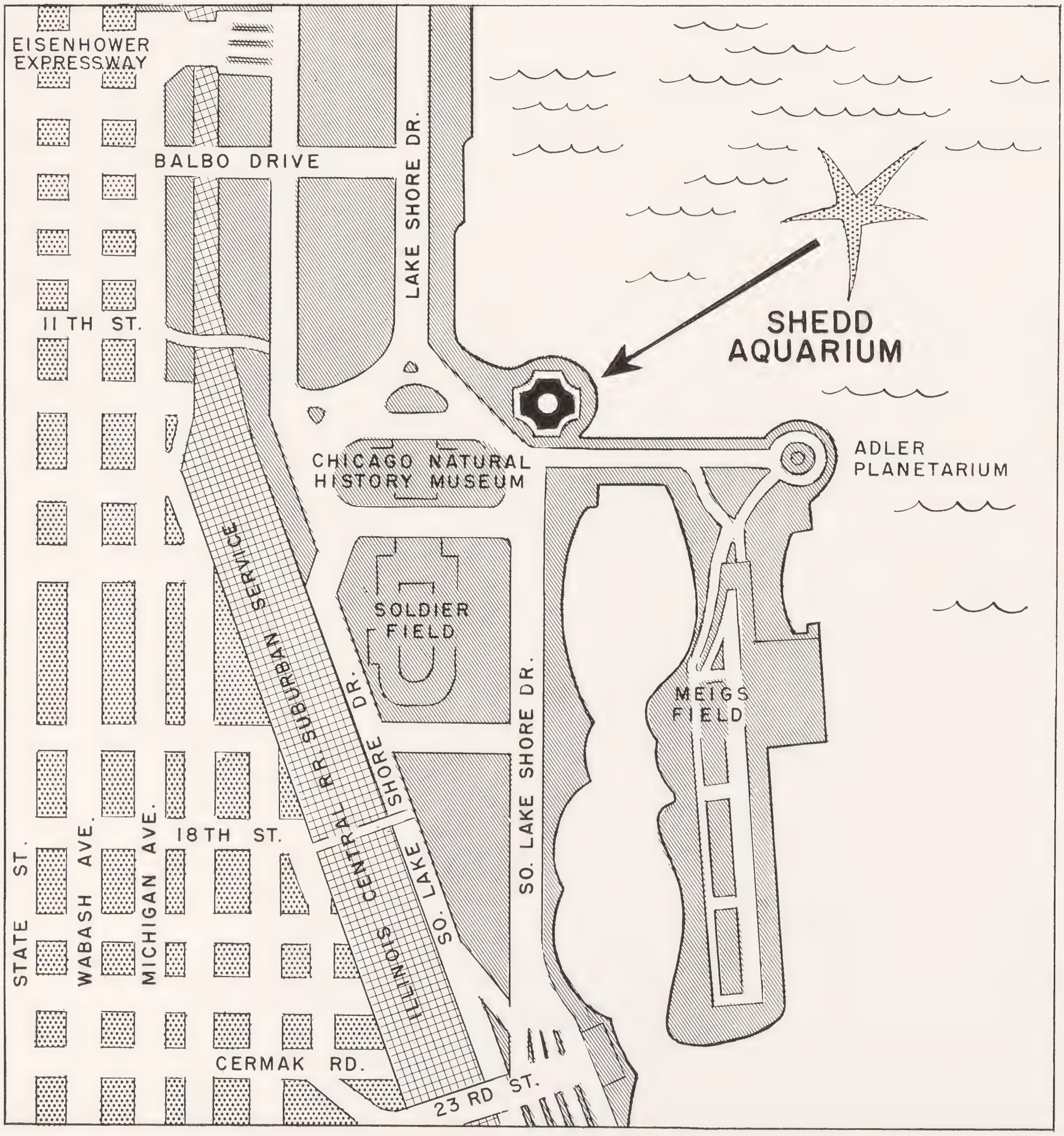
N. J. Russell is a Nairobi-based journalist. **Alexander Skutch** is a regular *Animal Kingdom* contributor. **Peter Brazaitis** is senior keeper in the Bronx Zoo's Reptile Department. **Dr. Fernando Nottebohm,** a native of Argentina, is on the staff of the Institute for Research in Animal Behavior.

ILLUSTRATION CREDITS

Cover — Frank Stevens; p. 97 — Frank Stevens; p. 98 — Sam Dunton, N.Y.Z.S. photo; pp. 101-105 — N. J. Russell; pp. 106-111 — drawings by Lloyd Sandford; pp. 112-116 — N.Y.Z.S. photos; pp. 117-118 — William G. Conway; pp. 119 — Paul Steinemann, Zoologischer Garten Basel; p.120 — Victoria Rowntree; p. 121 — N.Y.Z.S. photo; p. 122 — Bill Meng, N.Y.Z.S. photo; pp. 124-127 — N.Y.Z.S. photos.

Visiting Chicago?

For almost 40 years, visitors to the Windy City have stopped at the John G. Shedd Aquarium on the shores of Lake Michigan. Open every day except Christmas and New Year's, the Shedd Aquarium receives more than a million visitors annually. Hours: During May, June, July and August—9 A.M. to 5 P.M.; March, April, September and October—10 A.M. to 5 P.M.; November, December, January, and February—10 A.M. to 4 P.M.



This is one in a series of travel guides to zoos and aquariums presented by ANIMAL KINGDOM *as a service to its readers. We welcome submission of maps and information to be used on this page.*

NEW YORK ZOOLOGICAL SOCIETY

590.673
A59

VOL. LXX, NO. 5, OCTOBER, 1967

animal kingdom

NEW YORK ZOOLOGICAL SOCIETY
630 Fifth Avenue, New York, N. Y. 10020

President
Fairfield Osborn

First Vice-President;
Chairman, Executive Committee
Laurance S. Rockefeller

Vice-President
Henry Clay Frick, II
Robert G. Goelet

Secretary
John Elliott

Assistant Treasurer
Eben W. Pyne

Treasurer
David Hunter McAlpin

Assistant Secretary
Harold C. Palmer

BOARD OF TRUSTEES
(*Executive Committee**)
Alexander Aldrich, George F. Baker, Jr.*, Robert E. Blum, William R. Coe, C. Suydam Cutting, John Elliott*, Charles W. Engelhard, Henry Clay Frick, II*, Robert I. Gannon, Peter R. Gimbel*, Robert G. Goelet*, Peter Grimm, John N. Irwin, II*, Warren Kinney, Anthony D. Marshall, Otto Marx, Jr., David Hunter McAlpin*, Peter Matthiessen, G. W. Merck, Charles W. Nichols, Jr., Fairfield Osborn*, Augustus G. Paine, II, Howard Phipps, Jr., John H. Phipps, John Pierrepont*, Eben W. Pyne, Laurance S. Rockefeller*, David T. Schiff, John M. Schiff, Henry Sears, Chauncey Stillman, Joseph A. Thomas, Landon K. Thorne, Jr., Alfred G. Vanderbilt, Robert Winthrop.

Ex-Officio:
The Mayor of the City of New York, Hon. John V. Lindsay
Administrator of Recreation and Cultural Affairs, August Heckscher.

General Director
William G. Conway
John Tee-Van, *Emeritus*

ZOOLOGICAL PARK
William G. Conway, *Director & Curator of Birds;* Charles P. Gandal, *Veterinarian;* Hugh B. House, *Associate Curator & Chairman, Mammals;* Grace Davall, *Assistant Curator, Mammals & Birds;* David W. Nellis, *Mammalogist;* James G. Doherty, *Mammalogist;* Joseph Bell, *Associate Curator, Birds;* Donald F. Bruning, *Ornithologist;* F. Wayne King, *Associate Curator, Reptiles;* Herbert J. Knobloch, *Curator, Education;* Charles B. Driscoll, *Superintendent, Operations;* Edward Kearney, *Manager, Facilities Dept.;* Lee S. Crandall, *Zoological Park Consultant & General Curator Emeritus;* Roland Lindemann, *Consultant, Mammal Management;* John M. Budinger, *Consultant, Pathology.*

AQUARIUM
Ross F. Nigrelli, *Director;* Robert A. Morris, *Associate Curator;* Lars Mellkvist, *Superintendent, Operations;* Jewell Bungay, *Business Manager;* Louis Mowbray, *Research Associate, Field Biology;* Christopher W. Coates, *Director Emeritus.*

OSBORN LABORATORIES OF MARINE SCIENCES
Ross F. Nigrelli, *Director;* Martin F. Stempien, Jr., *Assistant to the Director;* George D. Ruggieri, S.J., *Coordinator of Research;* William Antopol, C. M. Breder, Jr., Jack T. Cecil, Harry A. Charipper, Kenneth Gold, Myron Jacobs, Klaus Kallman, Vincent Liguori, John J. A. McLaughlin, Martin P. Schreibman.

INSTITUTE FOR RESEARCH IN ANIMAL BEHAVIOR
(Operated jointly by the Society & Rockefeller University)
Donald R. Griffin, *Director;* Peter R. Marler, Jocelyn Crane, Roger S. Payne, Richard L. Penney, Fernando Nottebohm, George Schaller, Thomas T. Struhsaker, C. Alan Lill, O. Marcus Buchanon, *Resident Director, William Beebe Tropical Research Station.*

GENERAL
Walter Lerchenfeld, *Comptroller;* John McKew, *Personnel Manager & Assistant to the Director, Zoological Park;* Gordon Cuyler, *Membership Chairman & Administrative Associate;* Jerry M. Johnson, *Curator, Department of Exhibition and Graphic Arts;* Edward R. Ricciuti, *Editor & Associate Curator, Publications;* Dorothy Reville, *Assistant Editor;* Sam Dunton, *Photographer.*

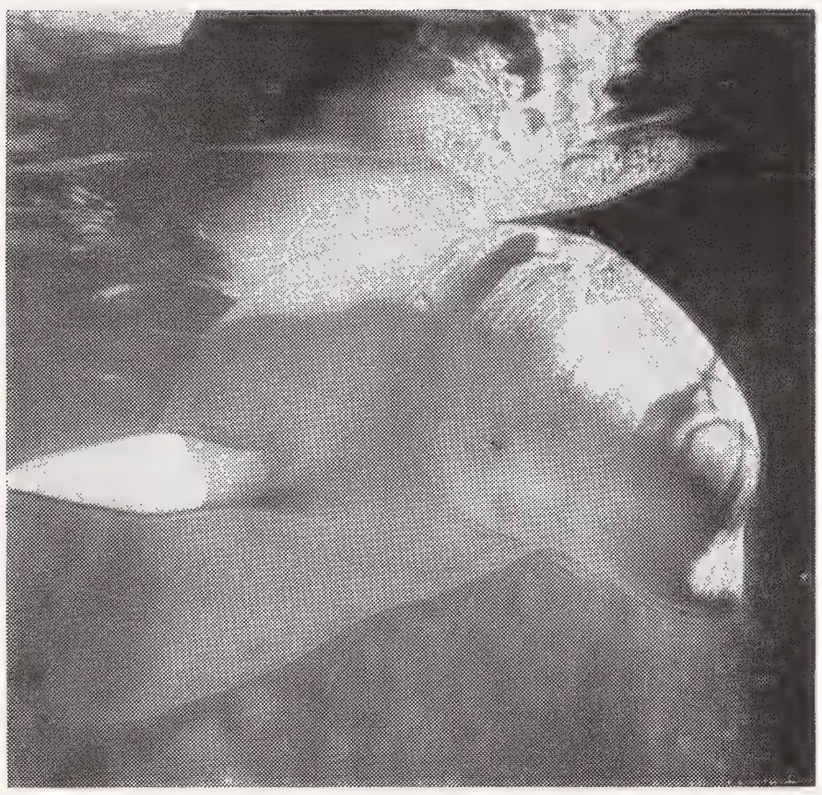
AFFILIATE
Jackson Hole Biological Research Station
L. Floyd Clarke, *Director.*

Issued bi-monthly by the New York Zoological Society at the Zoological Park, Bronx, N. Y. 10460. Editorial and Subscription Offices at the same address. Title registered with the U. S. Patent Office. Subscription, $3.50 a year; single copy, 60 cents. Same rates for all foreign countries and Canada. Second-class postage paid at Bronx, N. Y. Send Form 3579 to Bronx, N. Y. 10460

SMITHSONIAN
JAN 17 1968
LIBRARIES

animal kingdom

MAGAZINE OF THE NEW YORK ZOOLOGICAL SOCIETY VOL. LXX NO. 5 OCTOBER, 1967



ABOUT THE COVER

Newly arrived from the chill waters of upper Hudson Bay, the beluga on the cover now greets visitors to the whale tank at the New York Aquarium. An aquarium expedition recently returned with two female belugas, prospective mates for a pair of males which have been one of the aquarium's star attractions. This issue of ANIMAL KINGDOM takes you north with the expedition in quest of the white whales.

CONTENTS

WILDLIFE FIGHTS FOR SURVIVAL 130
by Stewart L. Udall,
United States Secretary of the Interior

THE EVERGLADES: ECOLOGICAL PUZZLE 134
by William M. Partington

WOLF
Victim of Calculated Slaughter 142
by John Hillaby

REPORT FROM RUAHA 146
by Royal Little

QUEST FOR THE WHITE WHALE
The New York Aquarium Brings Back Two Belugas 148
by Edward R. Ricciuti

ANIMAL KINGDOM REPORTS 157

THE BOOKSHELF 160

ABOUT THE AUTHORS 160

ILLUSTRATION CREDITS 160

Wildlife Fights
A SURVEY

By Stewart L. Udall, United States Secretary of the Interior

As the world's human population continues to soar, the protection of global wildlife becomes more difficult. Civilization — at least as we know it — means highways, cities, airports, noise, pollution of all sorts, intensive cultivation of soil, and many other land-eating practices. So wildlife, at least those forms that shy from people, retreats to ever-shrinking open space in search of survival.

But we are fortunate that interest in wildlife protection — which should mean *habitat* protection — is also mounting. There probably has never been in man's history so much interest in endangered wildlife all over the world. Public leaders are recognizing that wildlife is a precious resource to be perpetuated for future generations — possibly because our own species feels threatened. Whatever the reason, emerging nations of Africa continue to maintain preserves; giant powers like Russia have established programs and recently set special protection on the polar bear; European countries, more crowded with people than this land of ours, are playing a world leadership role in wildlife protection.

Many of the emerging countries, such as those in Latin America and Africa, are looking to the United States for guidance in natural resource management, particularly in conservation.

So I am particularly proud that the United States is part of the International Union for the Conservation of Nature and Natural Resources. Through this international body, which cuts across ideological differences among nations, we can exchange scientific information on wildlife habitat protection and management with any nation of the world. We can also convene international conferences when specific problems arise that need urgent attention.

The job of wise wildlife management cuts across boundaries and requires cooperation between sovereign states, since political entities mean nothing to our birds, mammals, and fishes. The United States, Canada, and Mexico represent an outstanding example of cooperation for protecting migrating wildlife; we are proud of this long, fruitful association.

Another cooperative program, this between the United States and Mexico, seeks protection for the endangered Sonoran pronghorn. Our biologists advise Mexican authorities on habitat management and range requirements.

A new, exciting arrangement between Canada and the United States has caught wide public interest. That program's goal is to increase the population of whooping cranes. Some of this species, long in danger of extinction, are now being reared in captivity in the hope that descendants can be released to the wild to thrive by themselves.

In June of this year, biologists of Canada's Wildlife Service located nests of whoopers in Wood Buffalo Park in the Northwest Territories. These scientists agreed with our biologists from the United States Bureau of Sport Fisheries and Wildlife to take an egg from each of six nests for incubation and hatching at Patuxent Wildlife Research Center in Maryland. Five chicks were hatched successfully

Whooping crane chick is one of five now being raised in Patuxent Wildlife Research Center in Laurel, Maryland.

for Survival

BY SECRETARY UDALL

and are developing nicely. They will become the nucleus of the breeding stock we hope to rear in captivity.

Taking one egg from each of the crane nests in no way affected the wild birds. Whoopers normally lay two eggs in a nest, but rear only one chick. We know that, after the eggs were taken, the birds did not abandon their nests, but returned to hatching the remaining eggs.

Other animals facing extinction stand to benefit from the new Endangered Species Preservation Act passed by Congress. Under it land will be acquired for preserving or developing a wild environment, special studies will concentrate on life histories and habitat needs of endangered species, and state agencies and private firms managing extensive land holdings will be asked to help in wildlife preservation.

Most of the federal guidance in research for protecting wildlife habitats is assigned to my department's Bureau of Sport Fisheries and Wildlife, which also administers our far-flung National Wildlife Refuge System, for waterfowl and many less-wandering species. Our refuges, found in 45 states, have more than 28 million acres dedicated to about 130 species of birds and mammals.

I want to stress that these lands are set aside specifically for wildlife *and* people seeking to know more about animals. Here biologists gather facts on the life histories of species and from this information determine what type environment will enable them to survive — and the refuges are carefully managed for maintaining this environment.

Some refuges are on the eastern seaboard near huge metropolitan areas, offering a vital habitat for waterfowl and other wild creatures

Bison herd moves from floor of the valley toward distant mountains in Montana's National Bison Range.

These bull elk are protected on National Elk Range in Jackson, Wyoming.

in the midst of urbanization. Bostonians, New Yorkers, and Philadelphians delight in such sites as Parker River and Monomoy in Massachusetts, Brigantine in New Jersey, Bombay Hook in Delaware, and Chincoteague in Virginia. The newly won Great Swamp Refuge in New Jersey, an hour's drive from downtown New York, will be a special treat for wildlife students, ecologists, and other people who simply want to see — and hear — what an area is like without concrete, asphalt, steel, and millions of milling pedestrians.

Other refuges are far from cities. Desert bighorn sheep are the *raison d'être* at Cabeza Prieta and Kofa Game Ranges in Arizona. "Buffalo" are back home on Bison National Wildlife Range in Montana and Wichita Mountain Refuge in Oklahoma. Musk oxen are protected on Nunivak Island off Alaska; there are more wapiti seasonally on National Elk Range in Wyoming than anywhere else in the United States.

But more *people* visit Aransas National Wildlife Refuge on the Texas Gulf Coast than any other. The reason: whooping cranes. The world's entire wild population — less than 50 birds — winters here, leaving for its nesting grounds near Canada's Great Slave Lake in early April.

Santa Ana Refuge on the lower Rio Grande shelters "Mexican birds" rarely found in the United States, such exotic species as chachalaca, pauraque, green jay, kiskadee flycatcher, and Lichtenstein's oriole. Santa Ana is also famous for its hawk flights; it perhaps is the best place in the country for migrating birds of prey, which aren't doing well these days.

The trumpeter swan is no longer classified as an endangered species. Its rescue was effected chiefly through protected nesting grounds within Red Rock Lakes National Wildlife Refuge in Montana's beautiful Centennial Valley. There the swans are provided solitude, the isolation necessary for survival.

Florida refuges such as Sanibel and Loxahatchee offer protection for herons and ibis — including large numbers of white ibis — along with limpkins and anhingas. Sanibel also has roseate spoonbills and sandhill cranes.

Then there's that superlative swamp setting

Such exotic Mexican birds as the chachalaca find shelter in the Santa Ana Refuge on the lower Rio Grande.

of cypress and live oak as a backdrop for fabled Okefenokee Refuge in Georgia, where ibis fly above the alligators that are disappearing rapidly in other areas, and where loggerhead turtles come out of the sea to lay their eggs in the sand.

Most Great Plains refuges were established primarily for migratory waterfowl use as breeding, resting, or feeding areas. But antelope, deer, prairie dogs, elk, and bighorn sheep live here, too, while longhorn cattle roam the Wichita Mountain Refuge in Oklahoma.

Outside refuges, the Bureau of Sport Fisheries and Wildlife assists public land custodians of the Forest Service, the National Park Service, and the Bureau of Land Management to develop vital wildlife habitats. Conservation agencies know that areas for timber, forage, and watershed protection can also serve as a habitat for wildlife and fishes.

Obviously, establishment of wildlife's place in the life pattern needs more than efforts of the Department of the Interior on refuges or on public lands. The Department of Agriculture, with its farm-wildlife work and its forest-game program of the Forest Service, is doing much for habitat protection.

But a major share of credit must go to state conservation agencies, and to private conservation groups such as the New York Zoological Society, and to individuals for their habitat protection and other conservation efforts. I would particularly congratulate their work in educating the public in intelligent wildlife management, for without the support and contributions of millions of individuals, all our programs on behalf of wildlife would be far less effective. Protection of wildlife — and human — environment is ultimately the responsibility of each individual.

WILLIAM M. PARTINGTON

THE EVERGLADES
ECOLOGICAL PUZZLE

(First in a series)

"THE HEAVY STENCH of death grows steadily over the glades," reported the front page of the *Miami Herald* May 12. An article recounting the grim facts of the drought that gripped Florida's Everglades was accompanied by three photographs – one of a shrinking pond full of bloated dead fish, another of a brush fire, and a third of a lone alligator in a drying mud hole.

Dozens of similar newspaper articles, in Florida and elsewhere, carried the same dismal message. The Everglades, which contains one of the nation's finest National Parks, was being destroyed by a combination of natural drought and human mismanagement.

Anyone living in south Florida since the first of the year had no doubt that a severe drought was underway. The evidence was clear, even in urban areas. In spite of heavy sprinkling, lawns and shrubs dried up. The air was hazy with thick, sooty smoke spawned by pinewoods fires and glades fires in the interior of the peninsula. Water turtles, from four-inch Florida mud turtles to platter-sized softshells, abandoned parched roadside ditches and were squashed by vehicles on the roads. White ibis and egrets ventured into towns to feed at park ponds and canals that still held water, leaving tracks and probing holes on the muddy shores. Above all, local newspapers were filled with items about the drought, telling of fish kills and stricken cattle and complaining that the federal government was trying to take over distribution of Florida's water supplies.

When it seemed the Everglades was doomed, however, catastrophe was averted. Rains, sometimes torrential, started falling on the Everglades and the 1.4-million-acre Everglades National Park three days after the *Miami Herald* article appeared. On June 8 this writer spent an evening with officers of the Florida Game and Fresh Water Fish Commission who were starting a program of tagging alligators within the park at the new Shark Valley Loop Road tower, south of the Tamiami Trail. Water filled the ditches alongside the road and flooded the sawgrass glades to the horizons. Southern bullfrogs grunted boldly from every pond and ditch, where numerous garfish and mudfish splashed. Willows heavy with new spring growth pushed in toward the center of the road. At dusk on the outgoing road, wood ibis and white ibis flew overhead by the dozens, and snowy egrets, common egrets, Louisiana herons, great blue herons, and little blue herons waded in the flooded prairies. Later that night the commission biologists not only found many breeding-sized 'gators in those ditches and the pits close to the road, but even heard a male roaring his reverberating mating call. Not a sign of drought disaster could be seen.

Wildlife seemed to suddenly make a remarkable recovery; it seemed almost as if the misguided seventeenth-century theory of spontaneous generation after rains was coming true. It wasn't, of course, but the drought dramatized how closely the problems facing the Everglades are tied to water. This is a complex situation, the center of much disagreement by experts whose engineering proposals and research programs are just starting to reach practical conclusions.

Let's look in more detail at south Florida and, in particular, at that watery complex often loosely called "The Everglades" – the physical features of the area, the wildlife for which it is famous, and above all the recurring problem of water supply for an ecosystem where every form of life sooner or later shows absolute dependence on water.

Anyone who has visited Florida knows that the southern part is extremely flat. Changes in elevation of only a few feet, or even a few inches, may cause surprising difference in soil and vegetation, and hence in the kind of animals living there. For instance, going from the Atlantic Ocean inland (west) in Palm Peach County for a distance of 15 miles, you cross native areas of coastal strand, tropical hammock, mangrove swamp, oak-palmetto scrub, pine flatwoods, cypress swamp, and sawgrass everglades, with changes of elevation from zero to 20 feet above sea level and back down to 10 feet.

A dried cypress swamp. The airplant, *Tillandsia,* is too dry to blossom, and no frogs were left in the epiphytes.

Except in the deeper waterways called sloughs, unblocked water flow through the Everglades has generally been slow, with great losses from evaporation, transpiration of the plants, and seepage into underground aquifers. Historically the Everglades region has probably depended largely on rainfall for its water supply, with considerable seasonal variation in overland flow dependent on rainfall in the northern part of this system.

Seasons, or even years, of drought have been common as long as any of the area's old-timers can remember. Even those who lived on the coast describe how they would sleep on the beaches at night to try to escape the choking clouds of smoke blowing in from the burning glades.

The central area of shallow water in the peninsula south of Lake Okeechobee is dominated by sawgrass, the chief component of the typical everglades. Much of this area has been converted to farmland. Characterized by minute spines that point toward the tip of each leaf, this sedge is most unforgettable to those who have had the experience of rubbing it the wrong way. Although it is too tough to be eaten by wildlife under most circumstances, the seeds produced on the ends of the long fruiting stalks are eaten by waterfowl, and the whole plant does provide some cover for almost everything in the glades, from deer to the small round-tailed muskrat. Scattered through this shallow "sea of grass" are many islands and willow marshes locally called "heads" or "hammocks," depending on the dominant plants.

Indian tribes — the "aboriginal" tribes, the Calusa and Tequesta, and finally the mixed northern races known collectively as "Seminoles" — inhabited the hammocks for hundreds of years. Boat trails for dugouts were made across the glades and sloughs. These are still used by hunters in airboats searching for native deer or the wild hogs that have been released by sportsmen's clubs and the Game Commisssion.

The sloughs and water holes made by alligators were formerly the last places to dry out during drought, and as aquatic life became concentrated in these places, wildlife gathered there to feed. Great flocks of birds were noticeable from a distance — egrets and many other herons, hawks, wood ibis, white ibis, vultures, as well as otters, raccoons, and water snakes. This sort of condition still occurs although canals have become another lasting source of water in dry periods.

Ideally, moderately dry periods should coincide with the winter or spring nesting season for the wading birds, making it easier for adult birds to catch the vast quantities of food needed for their insatiable young. Also, ideally, rains that come in late spring and summer can again convert the whole Everglades into a vast breeding ground for invertebrates and small vertebrates essential in the food chains that support wildlife. This would provide food for rails, limpkins, gallinules, grebes, and mottled ducks. Anyone visiting the Everglades in these summer rainy periods may still experience mosquito hordes of incredible proportion that seem resistant to all known brands of repellent. Although each species is specialized as to time of day it is active, the 50-odd species seem to be organized so that mosquito bites can be experienced conveniently at any time.

Further south in the Everglades National Park a broad zone of shallow, brackish water occurs below the Everglades proper that gradually gathers to form streams and rivers, and is dominated by mangroves. This is an estuarine zone of great importance for the production of organisms essential to the food chains of many species of wildlife as well as sport and commercial fish. Florida's most important single item of commercial seafood, the pink shrimp, grows to maturity in this zone. Indeed, these brackish zones are known to be among the most productive natural areas on earth. Here are located vast wading bird rookeries — Cuthbert Lake, East River, and Shark River. The majority of organisms produced in the brackish zones, however, may appear rather insignificant to the naked eye. Trophy-sized fish such as tarpon, snook, and trout are common only in the waterways.

Human interference with this shallow overland sea started in the 1880s with "improvement" of the Caloosahatchee River for navigation by extending it to Lake Okeechobee and

A healthy young cottonmouth is the only living reptile remaining in a dried cypress swamp in Florida's Palm Beach County, April, 1967.

Water rushing through Taylor Slough at Anhinga Trail, Everglades National Park in June, 1967, after the drought has been broken. This common egret is only one of the many animals of the area that suffer when the water level of the glades begins to subside. Changes in water elevation of only a few inches may alter the soil, vegetation, and animal life.

Scarcity of food during drought make it impossible to satiate the enormous appetite of these young birds.

A dried cypress swamp with fish killed by the drought. "The heavy stench of death grows steadily over the glades," reported the *Miami Herald* on May 12. Three days later torrential rain began falling on the Everglades and the 1.4-million-acre Everglades National Park, averting even greater catastrophe. Vegetation and wildlife returned to normal. The rich muck bottom of this area is now producing smartweeds and grasses, but the lessons of the drought are not soon to be forgotten.

widening the Kissimee. In 1903 the State of Florida authorized the Everglades Drainage District, which did its best to drain the glades for land reclamation with little thought of water conservation. Several major canals, still operating, were dug, including the Tamiami Trail (US 41) and Canal from Miami across the southern part of the Everglades proper. It was opened in 1928. Although culverts were placed under the trail to allow some water to flow south, these projects all unquestionably interfered with overland water flow from Lake Okeechobee toward what is now the Everglades National Park.

In 1948, a year after the dedication of the park, the Central and Southern Florida Flood Control District was authorized to take over the drainage system tangle from the Everglades Drainage District and other local districts. This state agency is designed to operate and maintain the huge system and additions to it constructed by the United States Army Corps of Engineers.

As areas of natural habitat became rarer in Florida, the Flood Control District and the Army Engineers received increasing criticism for destruction of native rivers, drainage of swamps, preferential treatment of farmers, wasteful discharges of water to the sea, and interference with overland water flow for Everglades National Park. This was accentuated by the dry years of 1962–65, when rainfall was below normal and the park became an issue of nationwide concern.

However, times and policies are changing. Both agencies are working with the Park Service on solution to water problems. The district has been meeting with conservationists to air complaints. In spite of constant pressures on the district to use conservation areas (1,345 square miles of Everglades set aside for water storage and recreation, containing a great deal of wildlife) for oil lines, television towers, cross-state roads, power lines, and seismic testing for oil, the district board is increasingly hesitant to admit commercial interests that would conceivably pollute or weaken reasons for retaining their surface rights to the conservation areas.

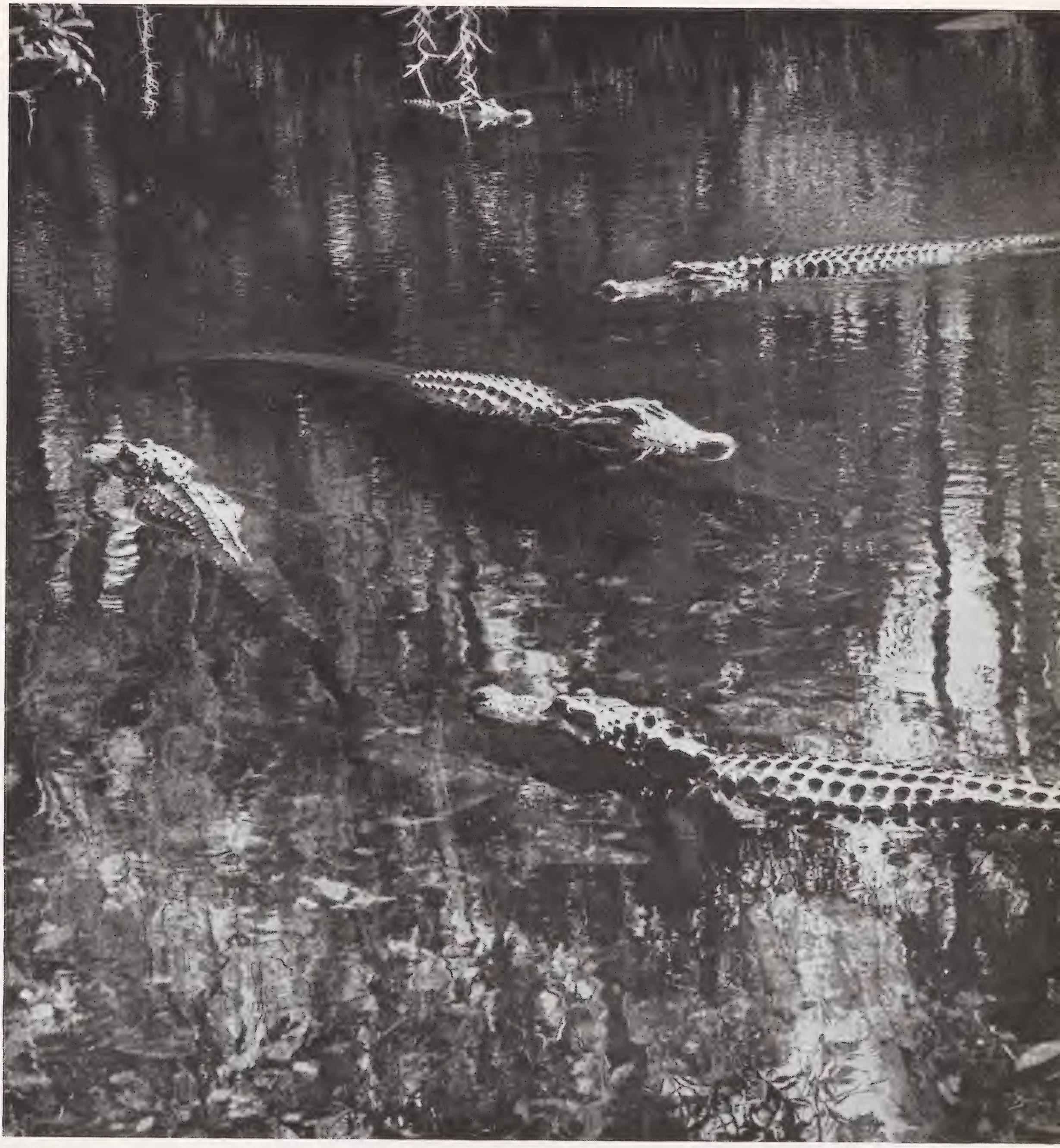
Before we finish with the natural and unnatural aspects of Everglades water conditions, there is one animal we should mention of great importance in this ecosystem – the alligator. Although it will feed on practically anything it can catch – crayfish, frogs, snails, birds, turtles, or unwary mammals – a major food item is garfish, a noted game fish predator. Again, old-timers tell us that fishing was dependably good wherever 'gators abounded, and even 12-footers were too shy to attack people.

The alligator's greatest contribution perhaps is that of large specimens who deepen their water holes and help keep waterways open during droughts. Some of these 'gator holes have underground tunnels or a pit in the deepest part and are the last places to hold water. Not only are these holes a source of water for terrestrial animals, but act as a survival area for many of the fishes, amphibians, and aquatic invertebrates that later breed explosively during wet seasons, spreading out through the glades. Because tiny mosquito fish survive in these 'gator holes they are usually quite free of mosquito larvae.

During droughts in more recent years, alligators, especially smaller ones, have moved overland into canals where some water remains. At one time this spring, the perimeter canals around the conservation area contained at least 1,200 'gators, although some of the larger ones stayed back in the southeast corner where the old Loxahatchee Slough stayed wet almost to the end. Dick Thompson, manager of the Loxahatchee Wildlife Refuge, reported that on May 15 this slough contained about 20,000 acres of surface water. On May 25 it had dropped to 10,000 acres, and by June 2, when the first important rains started in Area 1, the interior had probably dried completely except for the deeper 'gator holes. Mr. Thompson believes the overall value of alligators in the Everglades is greatly underestimated, an opinion apparently shared by everyone engaged in research on the ecology of the glades.

(*Next issue: the animals of the glades*)

The importance of alligators to the ecosystem of the Everglades was illustrated during the drought. The underground tunnels and pits of the water holes of these animals were often the last place to hold moisture and without this additional water many fish, amphibians, and aquatic invertebrates would not have been able to survive. At least 1,200 'gators were found in the perimeter canals around the conservation area at one counting this spring.



WOLF

Victim of Calculated Slaughter

by JOHN HILLABY

THE FAMILIAR picture is of a terrified traveler lashing his horses into a sweat with the pack hard on his heels. Or the little log cabin in the snow, surrounded by what seems to be every wolf in the state. All yowling and showing their canines. The impression always is of ferocity. Of ruthlessness. They are the killers. The enemy. They gave their name to German submarines in the Second World War. There is the crack Timber Wolf Division of the United States Army. Commandos who pass tests in military unscrupulosity are called Wolf Scouts.

Once numerous throughout the northern high latitudes, the gray wolf (*Canis lupus*) and its numerous variations had a geographic range greater perhaps than any other large land animal. This brought it into contact and conflict with the majority of the early peoples of the world. Resourceful and a keen hunter, it symbolized all that unsophisticated man had to contend with. Necessity, reward, sport, and prejudice drove it out of most of Europe.

In Britain it gave land-hungry pioneers an excuse to burn down the forests. Although refuges for wolf-oppressed travelers called "spitals" were still in operation toward the end of the sixteenth century, the last wolf is said to have been speared in the territory of the Mackintosh of Mackintosh in Inverness-shire in 1743.

The earliest references to the wolf in colonial America seem to be a few lines by a certain Captain John Smith. Describing the animals of Virginia in 1609 he wrote: "Ther be in this cuntry Lions, Beares, wolues, foxes, mushe catts, Hares, fleinge squirrells and other squirells."

Within 20 years the administrators of what is now Massachusetts had promulgated a wolf bounty. "It is ordered that evy Englishe man that killeth a wolfe in any pte within the limits of this pattent shall have allowed him 1d." The price soon rose to 40 shillings, a big sum in those days. During the years 1654–55 each Indian resident in Rhode Island was obliged to pay an annual tribute of two wolf skins, a form of taxation or tribute that goes back to Saxon England.

The wolf is now at bay in the United States. It has been exterminated in 39 of 49 states. The only substantial wolf populations are believed to be in Alaska and northern Minnesota with scattered remnants in Wisconsin, Michigan, and possibly Montana. All are reckoned to be in danger of extinction except, perhaps, for a pack on Isle Royale on Lake Superior. The smaller red wolf, which formerly ranged throughout the southern United States, is being gradually replaced by its relative, the coyote.

In Canada, with much of its vast expanse only sketchily surveyed by biologists, the situation is less precise, but there, too, the wolf seems to be declining with the large animals on which it preys, especially the caribou. For

Target of "smear tactics" the wolf is ruthlessly hunted. Photos here were taken in the Bronx Zoo.

a total of 2,753 wolves slaughtered in 1965, the Ontario government paid out $60,000 in bounties. For a hunter with a good eye and a telescopic sight clamped to his rifle a wolf-hunting trip is reckoned to pay off in cash for kills. A few months ago the Legislature only just managed to defeat the proposition that it should quadruple the wolf bounty and discharge a large number of game wardens.

In north Canada in 1953, I flew over a migratory line of caribou on the frozen surface of the Cree River. It extended for miles. Against the dazzling white background the animals looked like a sprinkling of dust on a soup plate. The pilot throttled back and pointed to a few specks, one behind the other, perhaps seven or eight in all, running alongside the herd. "Wolves," he said.

Back on the airstrip an old-time game ranger left no doubts about his opinion of wolves. "You gotta kill 'em," he said. "They're a-spreadin' the worm." The excuse for slaughter that year was that in its larval or hydatid phase a tapeworm carried by wolves was being transmitted to other animals. The belief is that the animals spread a variety of diseases from tularemia to smallpox.

To kill them the ranger used baits doped with cyanide and strychnine. Vast numbers, he boasted, had been slain among the eskers of Lake Athabaska. The previous year, he said, he had shot at wolves from a plane. The technique is to chase the wolf until the animal stops and rolls over on its belly in the typical dog gesture of surrender, whereupon a keen-eyed hunter with no special convictions about sportsmanship can shoot it in the belly.

Wolf-hatred has engendered diabolical methods of destruction. Aside from the usual armory of fall-traps and spring-primed engines that snap tight on the muzzle, the hunters hang up baits with fish hooks buried in the flesh. This leaves the animal dangling for days before it dies. The Eskimos have devised needle-pointed springs made out of whalebone which can be coiled up and frozen in a piece of bait. When devoured they thaw out gradually, uncoil and transfix the guts. Nothing is too bad for a wolf.

Extermination campaigns are based to a very great extent on factually unfounded mythology. The literature is rich in stories of blood-stained clothes and a few bones found in or around isolated homesteads, the relics of wolf attack.

However, dispassionate travelers have stated that the big Labrador wolf has never been known to attack a man. In Sault Ste. Marie, the center of a region renowned for its blood-curdling wolf stories, the editor of the local paper offered $100 for authenticated accounts of wolf attacks. The cash is said to be still in the till.

What it comes down to is that man is quick to unload his own fears and his own failures, especially in respect of land-management, on to vermin, one of the dirtiest smear-words in the English language. Highly intelligent wolves have been regarded as vermin for centuries.

Wolves are members of the Canidae, the dog family, a group of carnivora with slender limbs and non-retractile claws. The animals are adapted for speed on open ground. They have long jaws for snapping and slashing at their prey. Development of the Canidae's hunting methods led to assaults in groups, that is, teamwork, and finally to the highly complex social instincts and behavior patterns shown in modern dogs, wild and domestic. The life of the wolf is still much of a mystery and the tragedy is that it may not be unraveled before wolf populations sink to unrepresentative minima.

Wolves are adept at communication. Game wardens will tell you that when a pack of a few animals converges on, say, an isolated caribou they make the sort of conversational yodeling noise you can hear in an Alsatian dog. This seems to be the lupine equivalent of radio commands between units of a tank squadron.

Wolves also sing. This is more than an assembly call or a love serenade. It may show that they have selected a denning site. I have heard the noise in the Barrens, where, from recognized "choir lofts," they yowl through the night. Wolves also mark new territory so that an incoming animal knows whether it's likely to encounter a personal friend or a foe, a female in search of a mate, a young or an old, a sick or a hungry, hunted or gorged beast. They

urinate on a stone or a bush, a tree or a mound – any upright object, treating it as a dog treats a lamp-post. These are their odor points. They can be regarded as signal stations.

The public image of a predator is, at worst, of an enemy and, at best, a natural pruning knife, an animal that cuts down the sick and the unfit. Lions and wolves, weasels, otters, hawks, and owls are reckoned to be natural stabilizers. But this is only part of the picture. The regulation and inter-reaction of animal populations is an extraordinarily complex subject depending on inter-related factors such as cycles of abundance.

Predators kill what is most easily available. There is a strict predator-prey relationship. They don't practice over-kill. The abundance of one depends on the abundance of the other. And vice versa. Nimble carnivores such as wolves keep the laggards in motion. They prevent migratory animals such as caribou from what wildlife managers call yarding. This is a curiously inexplicable habit observable in deer which are apt to browse a yard down to the bare earth and stay there until they starve. Wolves act as traffic controllers, ensuring that the vegetation isn't over-grazed. They are, in fact, part of an irreplaceable complex of nature. And we may discover this when it's too late to do much about it.

Factually unfounded mythology has to a large extent been responsible for the extermination of the wolf.

Report from Ruaha

by Royal Little

(The East African nation of Tanzania is making great strides with its National Parks system. The Ruaha National Park is one of the nation's key wildlife areas. The New York Zoological Society has played a major role in development of this park.)

FIVE YEARS AGO, with several other interested individuals, I flew to Iringa in southern Tanzania to meet with local conservationists and businessmen to discuss the possibility of a national park in their area.

We found great enthusiasm for the project and were convinced that it would be advisable to encourage the government to put one of its large, nearby game reserves in the National Parks system, since all of the existing parks were in the northwestern part of that country. We made a thorough inspection from the air of the Selous and Ruaha Reserves, both of which have a permanent water supply from the large rivers which run through them. Each reserve had a wide variety of wildlife but Ruaha had a major advantage – the largest number of greater kudu surviving in any part of East Africa.

Shortly after our inspection, John Owen, the director of National Parks, advised the New York Zoological Society that Tanzania would include some 5,000 square miles of the Ruaha area in the Parks system and would pay all future operating expenses provided that the Society would raise, in the United States, $160,000 for initial capital expenditures such as headquarters buildings, bridges, and roads. The Board of Trustees of the Society quickly approved the project and notified the Tanzania government that the funds would be available.

Three years ago I revisited Ruaha with Mr. Owen and his wife, Patricia, to see the early stages of its development. The visit to Ruaha coincided with the start of the rainy season and there was considerable difficulty in getting out of the temporary airfield there. In the first place, it had rained so hard the night before that the river between camp and the field roared at flood crest, and we had to wade across the swift water. Our big, twin-engine plane was unable to get off the runway during several attempts, and we finally had to be shuttled one by one from this field to nearby Iringa in an antique single-engine plane.

It was natural, therefore, that after having made two trips to this wonderful game area, I should want to revisit it now that the facilities are well on their way to completion.

Our cross-country flight to Ruaha was perfect – the pilot came in over the airstrip without any problem. It was delightful to see the progress that had been made since earlier visits. John Savidge, now warden, has carried out the complete development program. There are eight airstrips – six for regular use and two for emergencies – 130 miles of roads have been built for visitors' use in addition to 160 miles of track that the staff can use for Land Rovers. Park headquarters is located at Msebe, and there are two ranger posts – one at the southeast boundary and the other at the northwest boundary. At headquarters there are staff quarters, with hot and cold running water, electric lights, a dispensary, a staff shop for supplies, workshops, and a hostel with bunks to accommodate 32 people. It is used by educational parties of school children and other visitors.

The permanent staff will be about 35 people, including a ranger field force of 12 in addition to drivers, mechanics, a clerk, mason, carpenter, engine man for the power plant, and gen-

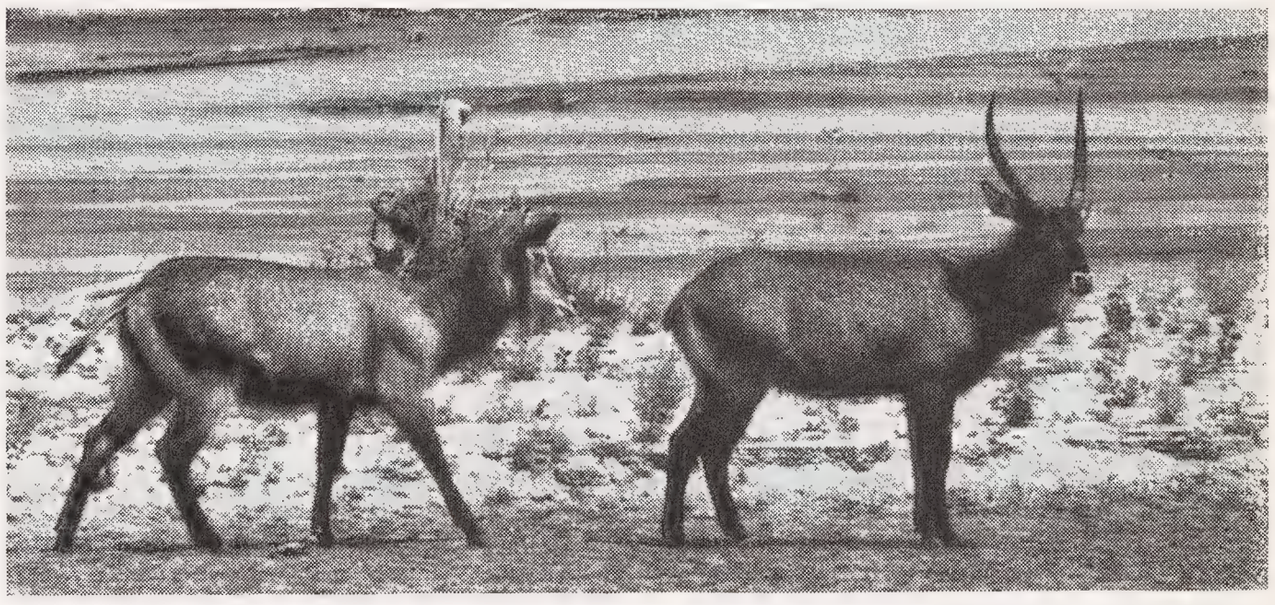
eral workers. To operate a park of this size, an assistant to the warden will also be needed.

This part of Tanzania has different wet and dry seasons than the northwest part of the country, where most of the other tourist attractions are located. Average rainfall is 23 inches during the months of December through March. The nights are cool and the temperature varies from 68° to 95° F. Long-term records indicate that there is no precipitation during the months of July, August, and September. Since it is necessary for the animals to leave the forests and mountains during the dry season to get water at the river, the best months for tourists to visit the park are August through November.

There is a fantastic variety of wildlife in the area, with over 300 species of birds and 40 species of mammals, including elephant, black rhino, hippo, buffalo, giraffe, several species of antelope, warthog, bushpig, lion, leopard, cheetah, and bat-eared fox. In addition, there is no other place in East Africa where the magnificent greater kudu bulls can be seen as regularly as along the banks of the Ruaha River during the dry season.

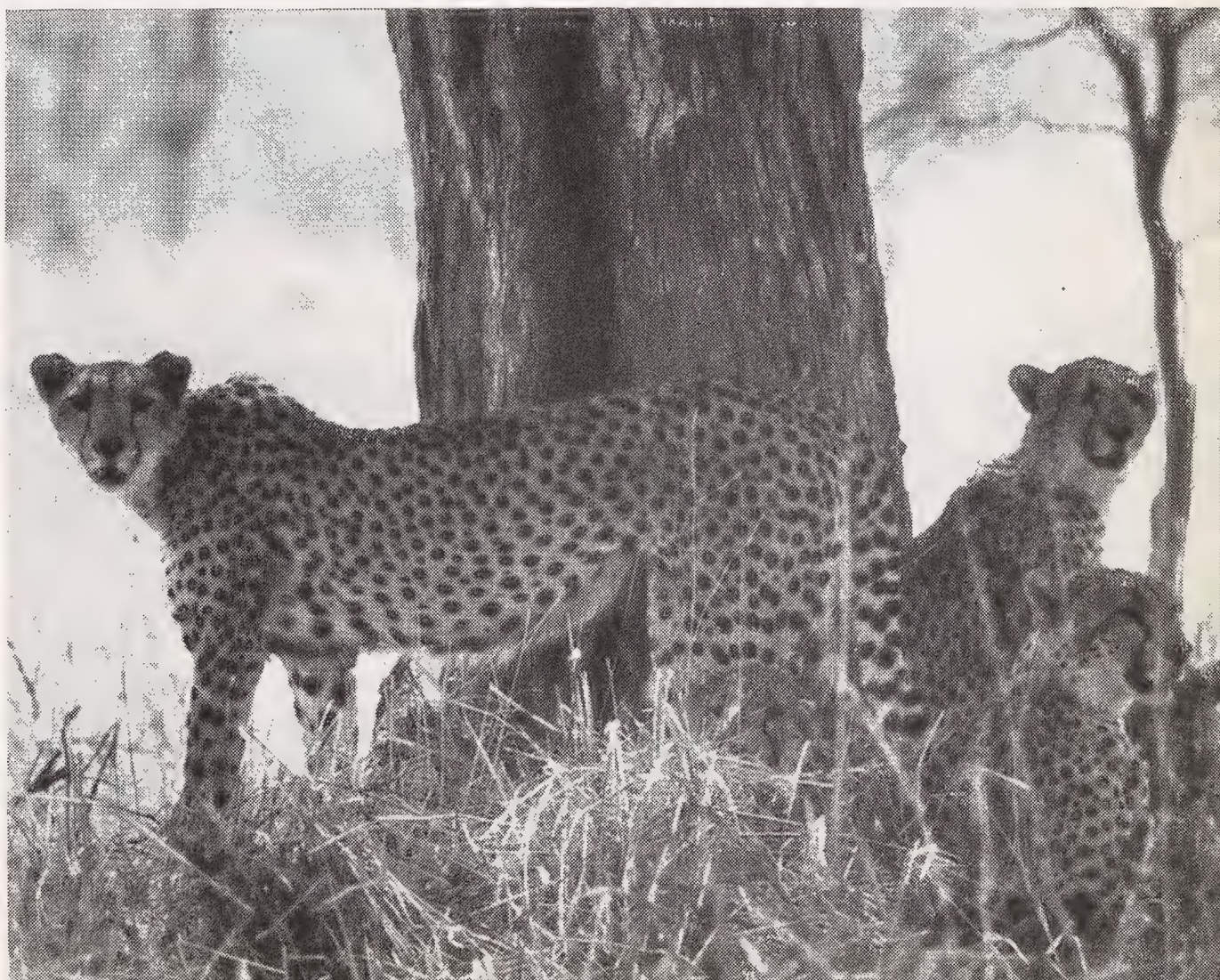
Certainly this park will some day be a major tourist attraction for Tanzania. It is possible that in the not too distant future East African Airways will run shuttle flights to all of the National Parks, including Ruaha, and open them up for more extensive tourist visitation.

The New York Zoological Society, through its African Wildlife Fund, can be justly proud of the part it played in making the Ruaha National Park possible.



Waterbucks inhabit plains adjacent to park streams.

Black rhino are among the 40 species of animals in the Ruaha National Park. Its name is misleading since the color of its hide is dark brown rather than true black.



The swift-running cheetah is one of several carnivores found in Ruaha's 5,000 square miles of land.

QUEST FOR THE

WHITE WHALE

THE NEW YORK AQUARIUM BRINGS BACK TWO BELUGAS

By Edward R. Ricciuti

It is extremely doubtful whether, at that precise moment, anyone on the bleak, subarctic beach could have envied Bob Morris. Wearing only a T-shirt, gym pants, and "sneakers," he perched on the edge of a round metal tank, about to plunge into the chill water within and wrestle a whale onto a canvas stretcher.

The wind gusting over the beach carried clouds of drizzle and an icy hint of the winter that has by now settled on Canada's northern Manitoba. A gloomy pall of fog masked the sun, newly risen over Hudson Bay. Nevertheless, an audience had gathered. Small clusters of Indians and a few Eskimos stood there in the gray September dawn, grins creasing their weathered faces. They were watching a criti-

cal stage in what must rank as one of the most unusual matchmaking efforts ever attempted.

The New York Aquarium hopes to breed belugas – white whales which range the Arctic seas. Bob Morris, associate curator at the aquarium, headed an expedition which last month brought two female belugas to the aquarium from northern Hudson Bay. The whales – prospective mates for the aquarium's two male belugas – were loaded aboard an aircraft September 7 at Churchill, Manitoba, for the long eight-hour flight to New York.

Some 1,600 miles and a day of gruelling work later, the female belugas were nosing about the aquarium's 100,000-gallon whale tank, separated from the males by a wire mesh fence. And as the whales were placed in their new home, a look of tired satisfaction appeared on Bob's face. The difficult task of shepherding the belugas halfway across North America was over.

For the past month, the whales have been

It's slippery going across the gravel of a beach on the Churchill River as the New York Aquarium's whalers haul a beluga, on a stretcher, from canoe to holding pool.

growing accustomed to their new environment. Once the aquarium staff is satisfied that the new whales have adjusted, the females will be introduced to the aquarium's males. Hopefully, biology will then take over.

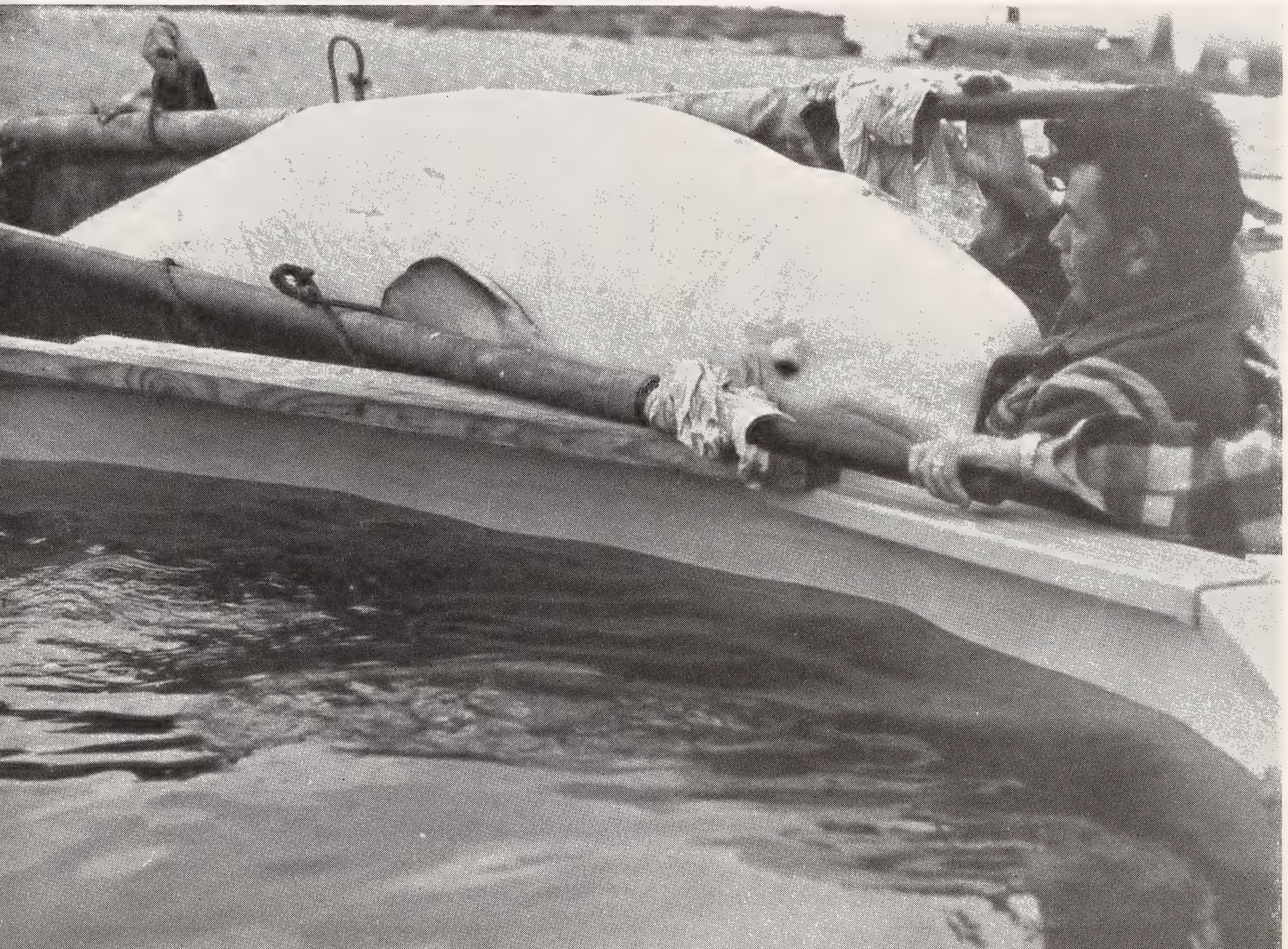
But even if mating does not occur, the presence of the females should at least promote harmony in the whale tank. The males have shared the tank for more than a half decade. Occasionally, during the mating season, they have displayed aggressive behavior and have had to be separated. Says curator Morris: "We hope the females will ease the problem."

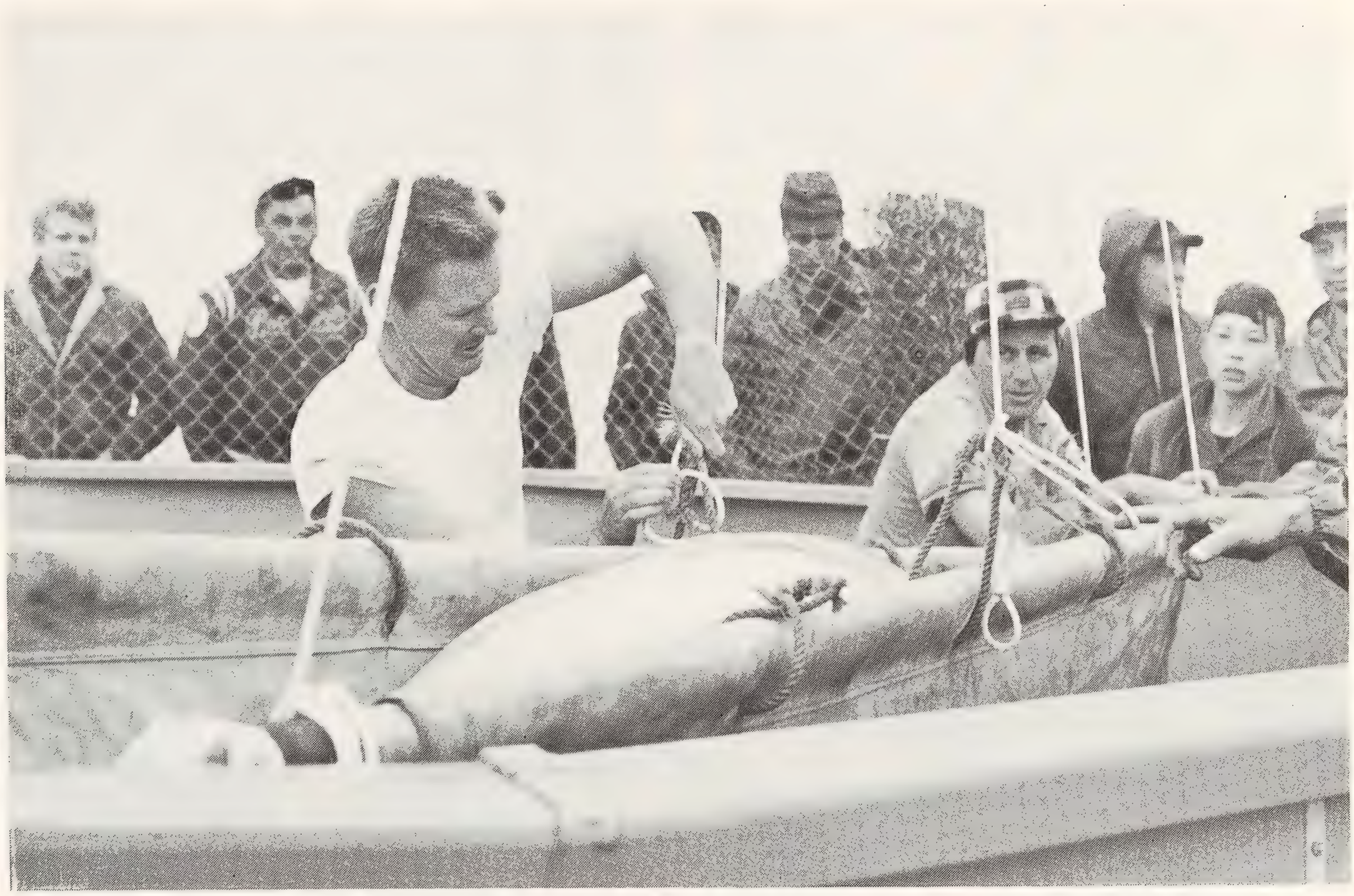
The aquarium expedition left New York August 24, bound for Churchill, a small community that rises from the tundra on the western shore of Hudson Bay. Built on a rocky spit of land between the Churchill River and the bay, this tiny settlement north of 50° Latitude boasts a towering grain elevator, where ocean-going freighters take on cargoes from western Canada. Fifteen miles away, rockets roar off launching pads at the Churchill Research Range – a far-north version of Cape Kennedy operated by Canada's National Research Council.

An aerial survey made soon after arrival of the aquarium party revealed large numbers of belugas concentrated near the mouth of the Seal River, 40 miles up-bay from Churchill. Morris recruited 16 Cree and Chippewa Indians, expert handlers of the 20-foot whaling canoes used by the expedition.

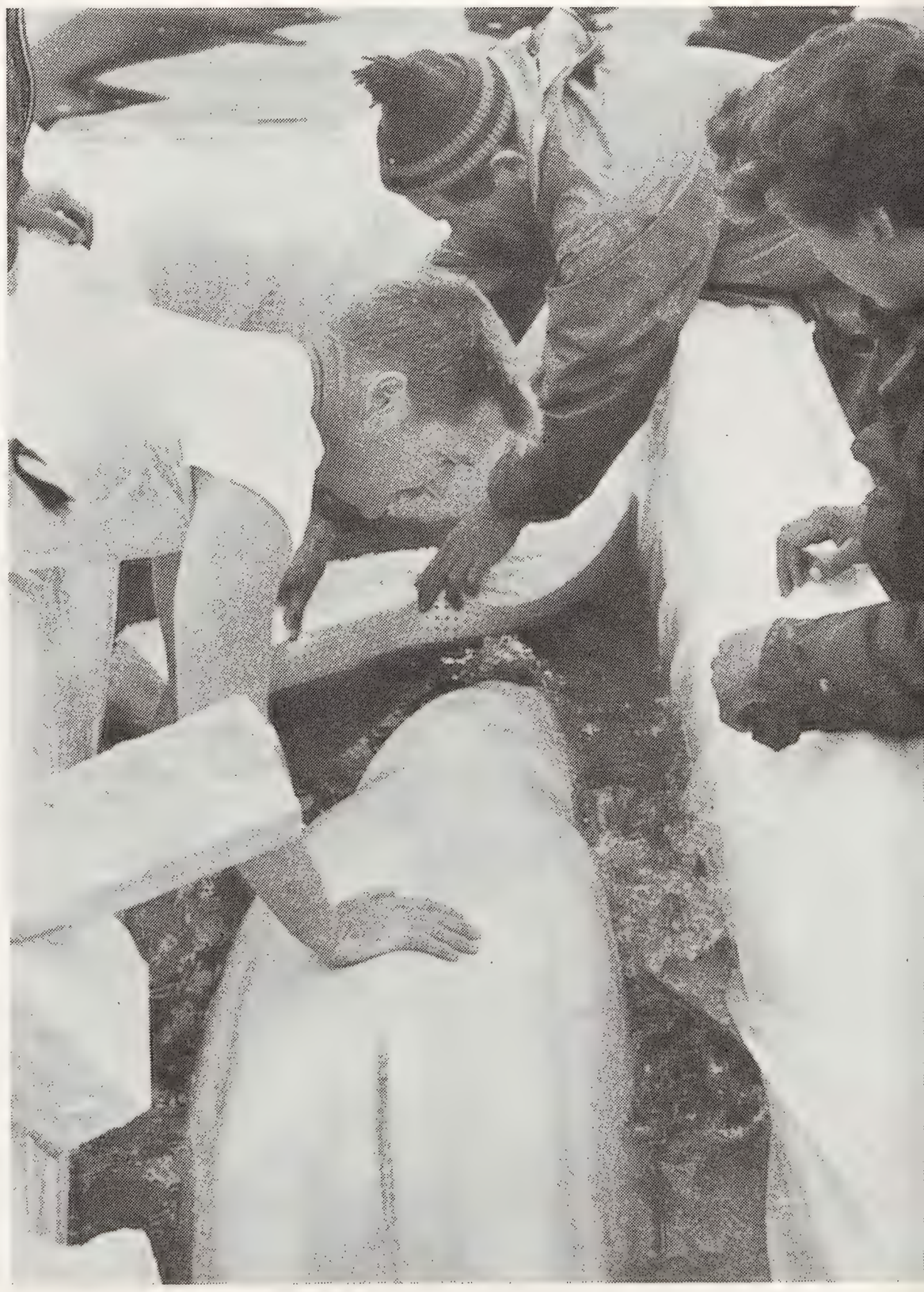
During the short summer, belugas are hunted in the Churchill area for oil, meat, and hides. Known also as killeluak, weisswäles, or, more whimsically, "sea canaries," belugas roam the entire top of the world. (This last appelation stems from the fact that belugas produce underwater sounds that are extremely audible above the surface.) Hugging the coast and at times venturing up large rivers, belugas some-

One last heave, and the whalers hoist the beluga to the brink of the holding pool. A moment after this photo was taken, the white whale splashed into the pool.





Bob Morris, left, and Charles Young secure lines on a stretcher as one of the aquarium's belugas is lifted by a powerful crane from the holding pool. Local Indians and Eskimos, members of the whaling party, watch.



Bob Morris checks the condition of one of his beluga charges after the whale is safely ensconced in a transportation crate, which is lined with foam rubber. Additional foam rubber was tucked around the whales to provide cushioning during the long trip to New York.

times travel in schools of several hundred animals.

Adults average about 14 feet in length and may weigh up to a ton. Despite their size, however, these white cetaceans move through the water with extreme grace. They are largely fish eaters, feeding on flounder, halibut, Arctic char, and similar species.

Because of their striking white color, playful behavior, and size, the aquarium's male belugas have long been a major attraction for visitors. Addition of the females makes the whale tank even more intriguing.

Along with Morris on the beluga expedition went the aquarium's animal manager, Charles Young, and Pedro Ponciano, a keeper. On Au-

gust 28, the expedition set out from Churchill aboard a flotilla of eight whaling canoes, outboard motors sputtering across the waters of the bay, and a large motor launch. About three hours later they reached a base camp, established by the Canadian Department of Indian Affairs at Seal River.

This region abounds with wildlife. Polar bears paddle through offshore waters. Caribou browse on the tundra. Wolves prowl both the open country and the sparsely wooded fringes of lakes that dot the area. Shore birds skitter about the beaches, disappearing and reappearing again among natural cairns of glacial rock. Canada geese and whistling swans pass overhead, splashing down on lakes and inlets. Foxes yip through the night around the base camp.

The first morning at Seal River the Indians shoved their canoes into the water and the whalers started out after belugas. Ideally, once a school of belugas is located, the animals should be herded toward shallow water by canoe. Morris had thus instructed his Indian helpers.

The excitement of the chase, however, soon proved irresistible. The well-planned herding procedures were quickly forgotten by the Indians and each canoe churned off in pursuit of its own beluga. Whales and boats crisscrossed the water; the result approached bedlam — shouts and laughter rang in the northern stillness, motors roared, whales flashed gleaming through the waves. Eventually, however, several animals were cornered in shallow water.

Running down a beluga requires a good boat. Collecting that same whale demands a willingness to undergo a thorough — and cold — soaking. The method is hardly complex: jump into the water, grab the animal by its tail, and hold on until someone else comes along with a canvas stretcher. Once the tail is held above the surface, the whale cannot swim. The animal is boated by jockeying it onto a stretcher, bound between sturdy pipes, and hefting the whale into a canoe, specially fitted with a lining of foam rubber.

The aquarium's pair of females are both approximately four or five years old, each nine-and-a-half feet long and slightly the heavier side of 600 pounds. One still retains the pearl-gray color of the subadult beluga.

Ferried back to Churchill, the whales were placed in metal holding tanks, similar to the round portable swimming pools that appear in suburban back yards in summer. The pools were set up on the beach near the Churchill whaling station.

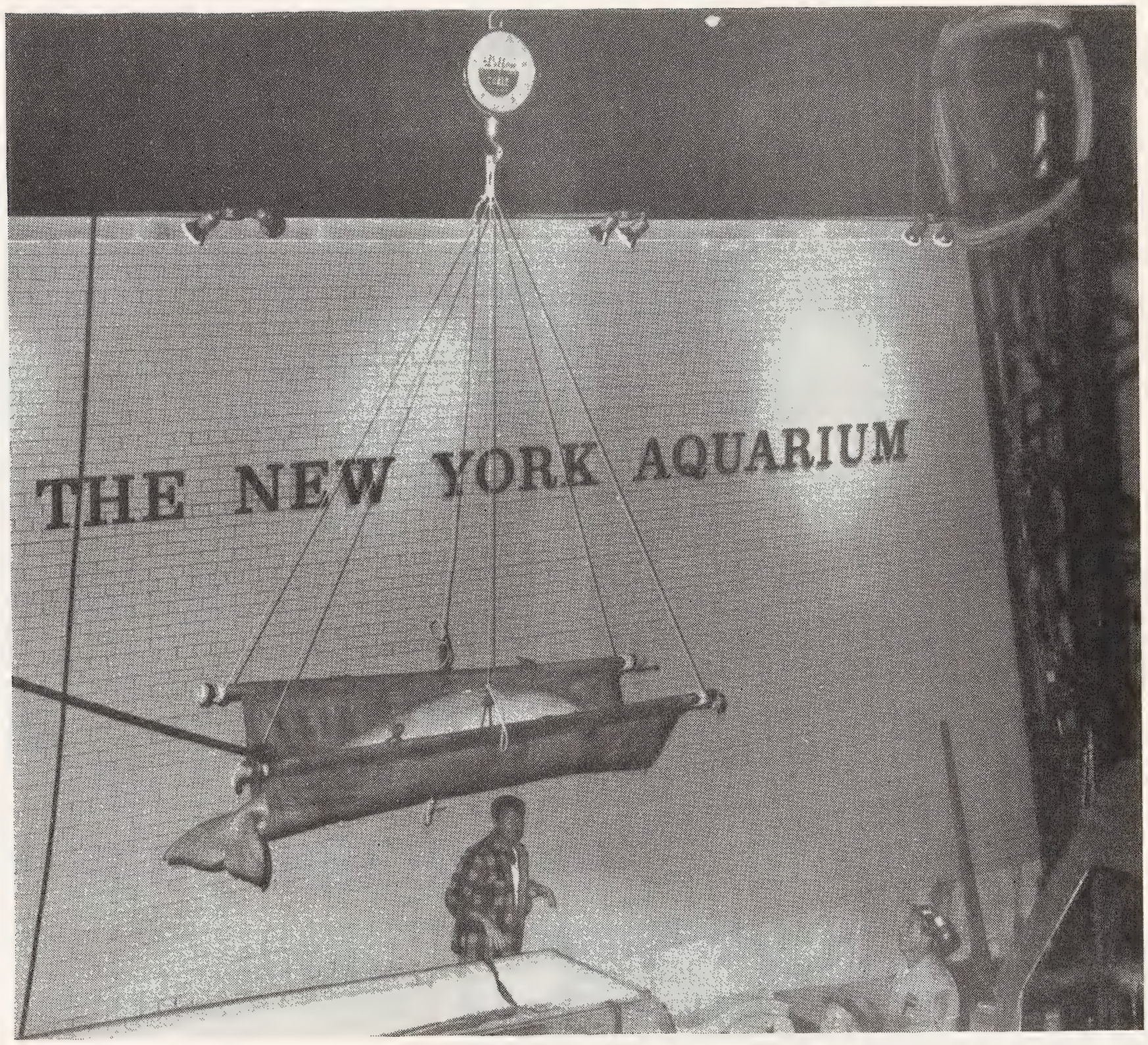
Moving a whale from canoe to holding tank takes the strength of more than a dozen men, all straining to carry the stretcher across the slippery beach gravel. There is much heaving, pushing, and puffing — and then the last surge of effort to raise the whale to the tank rim. The whale is poised there for a moment, then splashes into the tank.

While all this went on in the north country, an aircraft was on its way from Florida. At the Westchester County Airport outside of New York City, heavy crates, like the canoes lined with foam rubber, were loaded aboard the aircraft, a two-engine C-46 of World War II vintage. The chartered aircraft is regularly used to haul small tropical aquarium fish from South America. The plane had carried dolphins before, but never whales. Painted on the plane's fuselage were the words "El Orgulla de Leticia" ("The Pride of Leticia"), after a small riverbank town in Colombia. Noted pilot David Brown, a veteran of 27 years in the air: "We may change her name to the "White Whale."

Brown set the aircraft down on the unpaved runway outside of Churchill on September 6. Early the next morning, the aquarium team prepared to move the whales to the airport and load them aboard the plane.

Gulls soared over the beach in the misty dawn as Bob Morris hauled himself up on the edge of the holding tank, gingerly testing the 45° F. water with his feet. Pumping had lowered the water level until it was knee-deep. Morris dropped into the tank, where he was soon joined by a shivering Charles Young.

Meanwhile, a mobile crane provided by the Churchill Research Range had eased alongside the tank. The crane operator lowered the stretcher into the pool. Morris and Young, utterly drenched, managed to get the first whale on the stretcher. The crane creaked,



With one beluga already exploring the aquarium's whale tank, the second white whale rides its stretcher up to the top deck of the aquarium building and into its new home. Aquarium divers wait in the tank to ease the beluga from the stretcher into the water of the tank.

lifted stretcher and whale, and deposited the animal in one of the carrying crates, both of which were aboard a flatbed truck. The same procedure was repeated for the second whale.

By noon the whales, cushioned by foam rubber and water which had been pumped into the carrying crates by the local fire department, were airborne. Morris, Young, and Ponciano hovered over their charges, sponging them down and pouring vast quantities of ice cubes into the crates to maintain a cool water temperature. The aircraft's cabin heating had been shut off, further cooling the whales.

It was dark when the aircraft rolled to a stop on a runway at Brooklyn's Floyd Bennett U. S. Naval Air Station. Now it was the Navy's turn to pitch in. Willing sailors put their shoulders to the crates and within minutes the whales were safely within a trailer van.

A quick trip along the crowded Belt Parkway and the whales had reached another beach – this one at Coney Island, where the aquarium's buildings stand amid amusement rides and towering garden apartment complexes. A second crane came into play and the whales were lifted from their crates, lowered into the tank, and released.

Wheeling around their half of the pool, the females quickly approached the divider fence.

Soon after entering the tank, both females headed for the fence which separates them from the aquarium's resident males. Here male and female meet at the fence.

Acting anything but coy, they pushed against the fence, attracting their male tank mates. There was a quizzical look on the part of the males, then both made for the fence, swimming alongside it, preening, and emitting a variety of sounds. It was a good beginning for what the aquarium staff hopes will be a lasting and interesting relationship.

The journey over, the aquarium's female belugas glide through the blue water of the whale tank. Eventually, the aquarium hopes to breed these Arctic sea mammals.

REPORTS

The Red and the Black

Casual visitors to the Bronx Zoo's Aquatic Birds Building might easily pass it by — a rather drab bird, long-legged, covered largely with dull black plumage. But this bird rates a second look. It's a zoo rarity, a scarlet ibis born in captivity.

The young ibis was hatched August 15, the offspring of two of the zoo's seven adult ibis.

Female ibis feeds her newly born offspring at Bronx Zoo.

Next to its striking parents, which sport the flaming red color of a summer sunset, the youngster is somewhat nondescript. It takes at least three years for the characteristic scarlet color to appear. The male parent came to the Bronx Zoo from Washington's National Zoological Park.

The young ibis — with the adults — is on display in a river bank exhibit which greets visitors to the Aquatic Birds Building.

After it was discovered in its nest, the egg which produced the young ibis was placed in an incubator. Some time before, the female ibis had broken one of her eggs. A substitute egg, filled with plaster, was put in the nest.

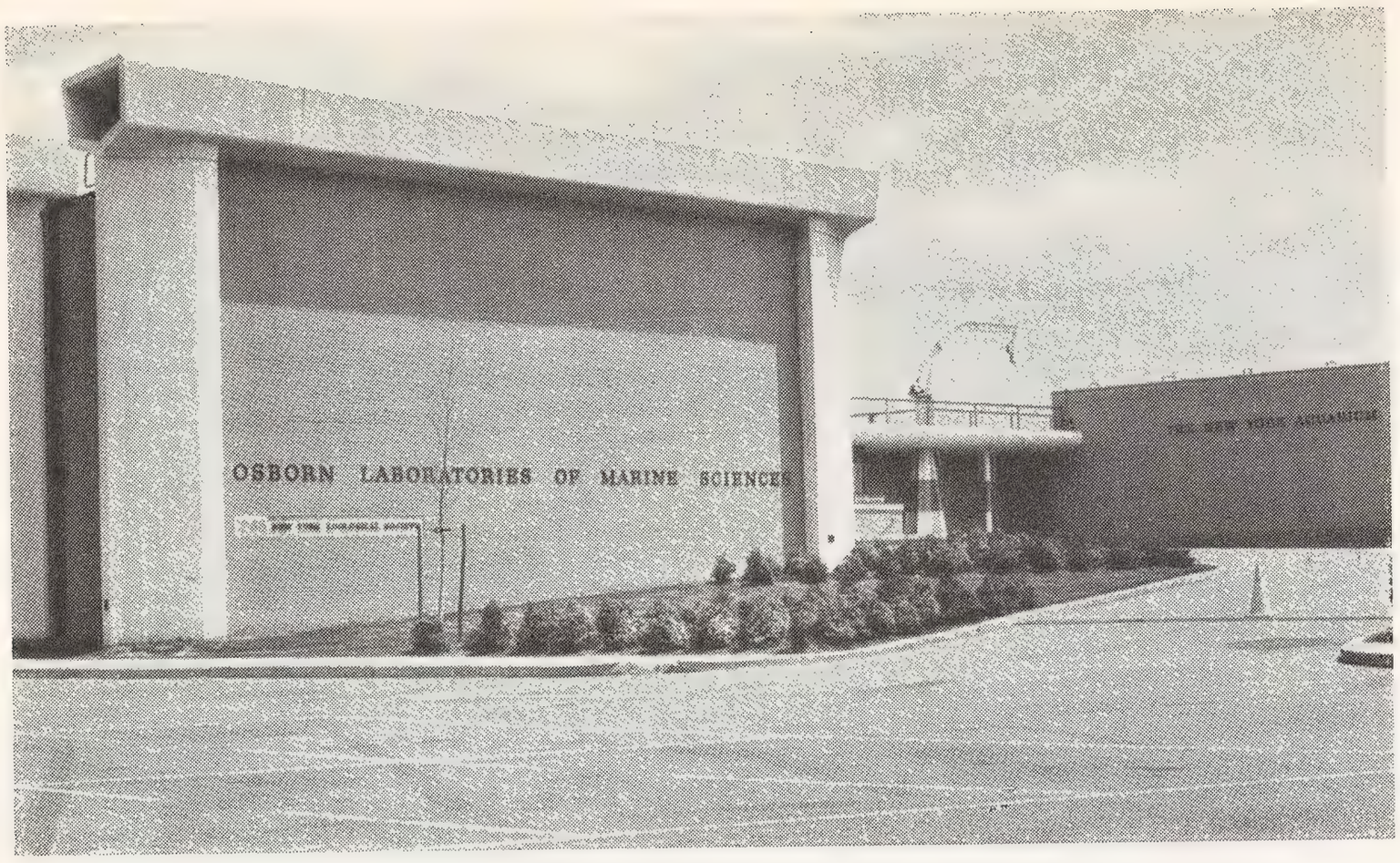
Joseph Bell, associate curator of birds, explains: "The female became restless and we had to take away the egg. When it finally hatched, however, we put the young bird, still cradled in what was left of the shell, back in the nest. The female removed the shell and within a few hours was feeding her offspring."

Osborn Laboratories

The Osborn Laboratories of Marine Sciences, a major center of marine research at the New York Aquarium, was formally opened with dedication ceremonies on September 28.

The laboratories are named for Dr. Fairfield Osborn, president of the New York Zoological Society since 1940. The Society operates the laboratories at the aquarium site in Brooklyn.

Construction of the new research institution began in May, 1965. Scientists have been at work in the building for several months, carrying on studies in some of the most exciting areas of marine biology, particularly in regard to the biomedical uses of natural marine products. The laboratories' research program in large measure expands areas of investigation that have dominated research at the aquarium for several years.



The Osborn Laboratories of Marine Sciences, named for Dr. Fairfield Osborn, were formally dedicated on September 28.

Osborn Laboratories research groups are, for instance, probing the intelligence of dolphins and whales, studying the complex web of the sea's food chain, and evaluating and testing chemicals – derived from marine animals – which may have valuable medical applications.

This new center of marine sciences is the first of its kind in any of the world's large cities. It is located within easy reach of both the many educational and scientific institutions of New York City and the Atlantic Ocean.

Director of the laboratories is Dr. Ross F. Nigrelli, recognized internationally as an authority on the diseases of fish and other marine animals. Former president of the New York Academy of Sciences, Dr. Nigrelli is also director of the New York Aquarium.

"The Osborn Laboratories of Marine Sciences is an integral part of the New York Aquarium," Dr. Nigrelli explains, "and as such the laboratories have access to the aquarium's complex facilities and the long experience of aquarium personnel in collecting, shipping, and maintaining marine organisms. This will be needed to facilitate and accelerate biochemical and pharmacological studies by scientists at the laboratories."

Invasion Warning

A potentially disastrous invasion of the Mediterranean Sea by foreign organisms via the Suez Canal has been predicted by a leading Danish marine biologist.

The warning was made at an international conference held last month at the Duke Marine Laboratory, Beaufort, N. C. The conference was concerned primarily with rearing of marine invertebrate larvae, the stage in which these ocean animals are most mobile and often most susceptible to changes in their surroundings. Knowledge in the field is considered essential to future plans for sea farming and for tapping the enormous food potential of the oceans.

The "Suez Crisis of 1970" will be the one remembered by historians 200 years hence, according to Dr. Gunnar Thorson, noted marine biologist and director of the Marine Biological Laboratory, University of Copenhagen.

It will involve the invasion of the Mediterranean by animals strange to the area and the complete alteration of the structure of animal life in that body of water. The animals now are able to move through the Suez Canal with potential "catastrophic results."

"This is the greatest marine crisis in the world today," Dr. Thorson said, adding that it is a crisis that is building because of modern developments.

For many years after its opening, the high salt solution of the Bitter Lake along the route of the canal served as a filter against marine organisms moving through the canal from the Red Sea. But the salt deposits on the lake bottom have washed out, thus removing the natural filter.

In addition, recent dredging of the canal to make it wider and deeper and control of Nile River flood waters by the Aswan Dam have created conditions through which Red Sea animals could move.

For a number of years the invasion had been confined to adult shallow water animals. But

now the conditions are right for many deep water species to move through in larval form.

Compounding the problem is the fact that the Red Sea is rich in animal life while the eastern Mediterranean is relatively poor in animal species.

"One predator may come through and find the right conditions and do tremendous damage," Dr. Thorson said. "The results could be disastrous. The invasion will fully alter the fauna of the Mediterranean."

Dr. Thorson also noted the possibility of genetic aberrations as the marine life of the two seas combine and possible lessons for other man-made projects which impinge on the ocean environment.

The scientists and college professors at the conference also heard that larvae of small tropical marine animals can ride ocean currents in a gigantic circle from Africa to South America, up the coast of Central and North America, and back across the Atlantic to western Europe.

This phenomenon, said Dr. Rudolf S. Scheltema, associate scientist at Woods Hole Oceanographic Institution, demonstrates a genetic link between animal varieties otherwise separated by thousands of miles of ocean and poses questions about the importance of geographical isolation in evolution.

It has been believed that most evolution required reproductive isolation for species changes to occur, he said. But his research indicates that in the ocean, the introduction of genetic material from east to west is at least as frequent as natural mutation.

Dr. Scheltema said that two considerations had to be proved to demonstrate his theory: that tropical marine invertebrate larvae existed in this network of currents and that the larvae could remain in larval form long enough to make the journey.

Largest and most spectacular of North American woodpeckers, the ivory bill is still with us. This encouraging report comes from the Big Thicket country of east Texas. Three pairs of ivory bills have been sighted there. For all practical purposes the ivory bill has been thought to be extinct for almost 20 years. Sightings of the birds have persisted and this latest report raises hopes that the ivory bill may not pass over the brink into extinction. Formerly the ivory bill ranged through the states of the southeast and lower Mississippi Valley region. Historically, it has been a bird of forested swamplands, particularly those containing large, mature trees.

THE bookshelf

THE IMPERIAL COLLECTION OF AUDUBON ANIMALS, Extracts from the original text of *The Viviparous Quadrupeds of North America,* by John James Audubon and John Bachman. Edited and with new text, by Victor H. Cahalane. Foreword by Fairfield Osborn. Reproductions, in color, of 150 drawings by John James Audubon and John Woodhouse Audubon. XVI + 307 pp. Hamond, Inc., Maplewood, N. J. 1967. $19.95 (later $25).

John James Audubon, whose name is so closely related to the study of birds, was born at Les Cayes, Santo Domingo (now Haiti), on April 26, 1785, son of a French naval officer. His ensuing education in France, where he was taken by his father, in no way prevented his complete assimilation into the post-colonial life of America, where his devotion to the study of natural history led him to adapt readily to the life of a woodsman. His continuing studies resulted in the production, from 1827 to 1838, of the great volumes of *The Birds of America,* which eventually brought him fame and the reverence in which he has since been held.

In 1839, having completed the drawings for *The Birds of America,* Audubon conceived the idea of producing a similar work on mammals. Some years earlier, by chance, he had made the acquaintance of the Reverend John Bachman, pastor of a Lutheran church in Charleston, South Carolina. Bachman, an accomplished naturalist, had an extensive knowledge of American mammals and undertook to write or edit the accompanying text.

With little printed material available and scattered museum specimens difficult to reach, the task was monumental. Consequently, the third and final volume of *The Quadrupeds* did not appear until 1854, three years after Audubon's death. His son John Woodhouse Audubon, who had assisted in the drawings throughout, completed the work for the Imperial folio. An octavo edition of three volumes, under the simpler title of *The Quadrupeds of North America,* also was completed in 1854.

The present handsome publication will be of more than mere historical interest to both the general reader and the serious student of mammalogy. Dr. Osborn's foreword outlines briefly but clearly the production of the original *Quadrupeds* and assesses appreciatively the value of Mr. Cahalane's comments. These and the arrangement of the volume are fully praiseworthy. Originally bound without regard to relationships, as the paintings were finished, a more realistic system presents the subjects in zoological order. In general, each species is given two pages. At the left, under the technical and common names used by Audubon and Bachman, are selected excerpts from their text. At the top of the following right hand page is a color reproduction of the original illustration, with current names of modern usage. Following this are the expert comments of Mr. Cahalane, bringing the text into accord with present practice. As might be expected from the scant knowledge of the period and the difficulties of travel and communication, some errors of identification occurred.

Altogether, both publishers and editor are to be congratulated on a superb and useful production. L. S. C.

ABOUT THE authors

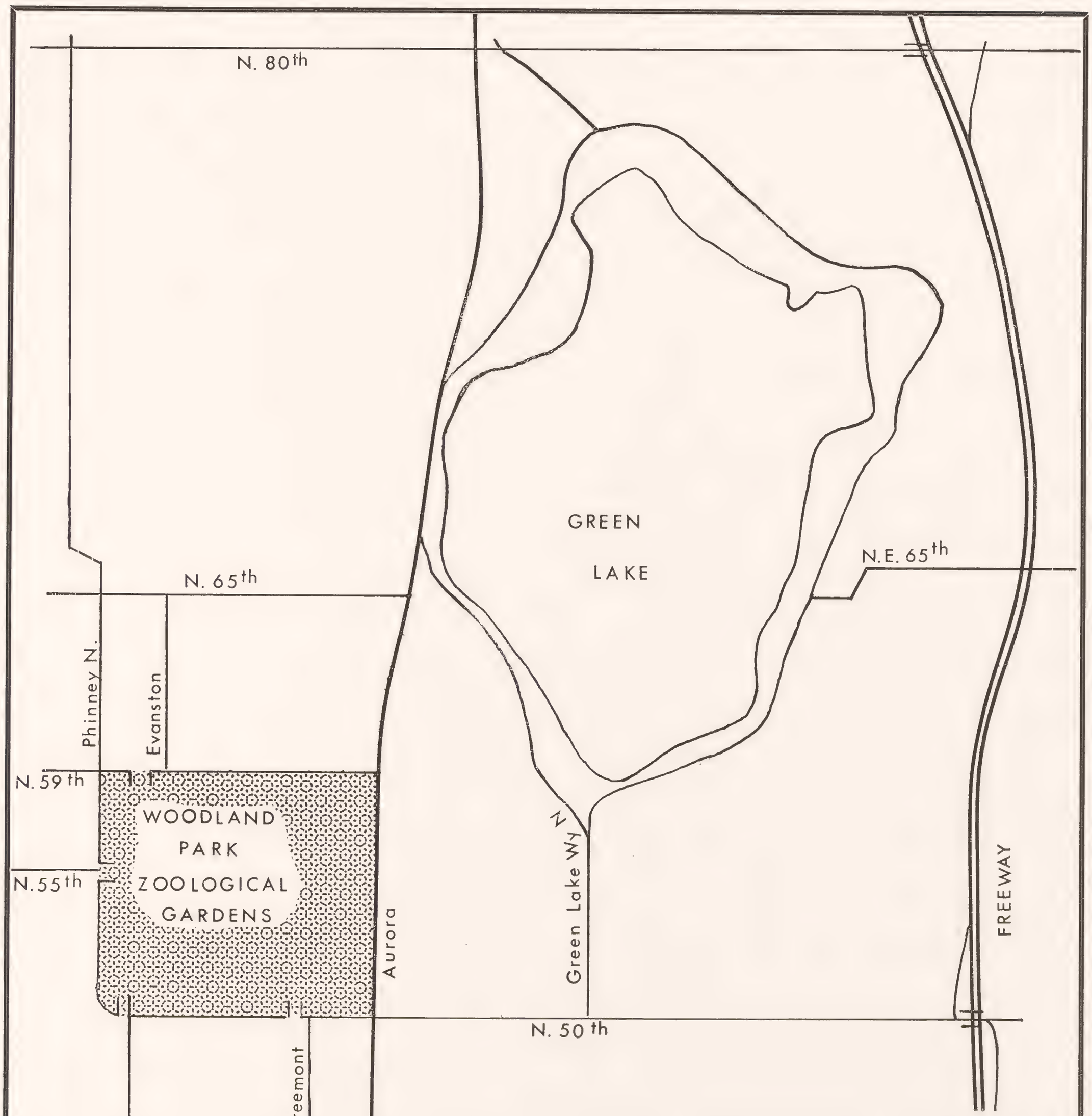
Stewart L. Udall, United States Secretary of the Interior, writes in this issue on preserving our wildlife heritage. **William M. Partington** is active in Florida conservation circles. **John Hillaby** is a science writer whose work appears regularly in the *New Scientist.* **Royal Little** is a Benefactor of the New York Zoological Society. **Edward R. Ricciuti** is Associate Curator of Publications for the New York Zoological Society.

ILLUSTRATION CREDITS

Cover — William Meng, N. Y. Z. S. photo; p. 131 — U. S. Fish and Wildlife Service, Rex Gary Schmidt; p. 133 — U. S. Fish and Wildlife Service, Luther Goldman; pp. 134, 137-39 — William M. Partington; p. 141 — Florida Game and Fresh Water Fish Commission; p. 142 — N. Y. Z. S. photo; p. 145 — Frank Stevens, N. Y. Z. S. photo; p. 147 — John Savidge; pp. 151-56 — William Meng, N. Y. Z. S. photos; pp. 157-58 — N. Y. Z. S. photos; p. 159 — Dr. A. A. Allen, National Audubon Society.

VISITING SEATTLE

Seattle's Woodland Park Zoological Gardens are open 8 A.M. until sunset every day of the year. There is no admission charge. The Woodland Park Zoological Gardens exhibit more than 1,900 specimens of animals. Among its special attractions are the ape house, feline house, bear grotto, and aviary.



This is one in a series of travel guides to zoos and aquariums presented by ANIMAL KINGDOM *as a service to its readers. We welcome submission of maps and information to be used on this page.*

NEW YORK ZOOLOGICAL SOCIETY

590.673
A59

animal kingdom

VOL. LX, NO. 6, DECEMBER, 1967

THE EVERGLADES PART II

SMITHSONIAN
JAN 17 1968
LIBRARIES

Issued bi-monthly by the New York Zoological Society at the Zoological Park, Bronx, N. Y. 10460. Editorial and Subscription Offices at the same address. Title registered with the U. S. Patent Office. Subscription, $3.50 a year; single copy, 60 cents. Same rates for all foreign countries and Canada. Second-class postage paid at Bronx, N. Y. Send Form 3579 to Bronx, N. Y. 10460

NEW YORK ZOOLOGICAL SOCIET

630 Fifth Avenue, New York, N. Y. 1002

President
Fairfield Osborn

First Vice-President;
Chairman, Executive Committee
Laurance S. Rockefeller

Vice-President
Henry Clay Frick, II
Robert G. Goelet

Secretar
John Ellio

Treasurer
David Hunter McAlpin

Assistant Treasure
Eben W. Pyn

Assistant Secretar
Harold C. Palme

BOARD OF TRUSTEE

(*Executive Committee**

Alexander Aldrich, George F. Baker, Jr.*, Robert E. Blum William R. Coe, C. Suydam Cutting, John Elliott*, Charle W. Engelhard, Henry Clay Frick, II*, Robert I. Gannon Peter R. Gimbel*, Robert G. Goelet*, Peter Grimm, Joh N. Irwin, II*, Warren Kinney, Anthony D. Marshall, Ott Marx, Jr., David Hunter McAlpin*, Peter Matthiesse G. W. Merck, Charles W. Nichols, Jr., Fairfield Osborn* Augustus G. Paine, II, Howard Phipps, Jr., John H Phipps, John Pierrepont*, Eben W. Pyne, Laurance S Rockefeller*, David T. Schiff, John M. Schiff, Henr Sears, Chauncey Stillman, Joseph A. Thomas, Landon K Thorne, Jr., Alfred G. Vanderbilt, Robert Winthrop.

Ex-Officio:
The Mayor of the City of New York, Hon. John V. Lindsa
Administrator of Recreation and Cultural Affairs, Augus Heckscher.

General Director
William G. Conway

ZOOLOGICAL PAR

William G. Conway, *Director & Curator of Birds;* Charle P. Gandal, *Veterinarian;* Hugh B. House, *Associate Cura tor & Chairman, Mammals;* Grace Davall, *Assistant Cura tor, Mammals & Birds;* David W. Nellis, *Mammalogist* James G. Doherty, *Mammalogist;* Joseph Bell, *Associat Curator, Birds;* Donald F. Bruning, *Ornithologist;* I Wayne King, *Associate Curator, Reptiles;* Herbert Knobloch, *Curator, Education;* Charles B. Driscoll, *Super intendent, Operations;* Edward Kearney, *Manager, Facil ties Dept.;* Lee S. Crandall, *Zoological Park Consultant General Curator Emeritus;* William Bridges, *Curator Publications Emeritus;* Roland Lindemann, *Consultan Mammal Management;* John M. Budinger, *Consultan Pathology.*

AQUARIUM

Ross F. Nigrelli, *Director;* Nixon Griffis, *Administrativ Assistant;* Robert A. Morris, *Associate Curator;* La Mellkvist, *Superintendent, Operations;* Jewell Bungay, *Bu iness Manager;* Louis Mowbray, *Research Associate, Fiel Biology;* Christopher W. Coates, *Director Emeritus.*

OSBORN LABORATORIES O MARINE SCIENCE

Ross F. Nigrelli, *Director;* Martin F. Stempien, Jr., *Assis ant to the Director;* George D. Ruggieri, S.J., *Coordinato of Research;* William Antopol, C. M. Breder, Jr., Jack T Cecil, Harry A. Charipper, Kenneth Gold, Myron Jacob Klaus Kallman, Vincent Liguori, John J. A. McLaughlin Martin P. Schreibman; Eva K. Hawkins.

INSTITUTE FOR RESEARCH IN ANIMAL BEHAVIO

(Operated jointly by the Society & Rockefeller University

Donald R. Griffin, *Director;* Peter R. Marler, Jocely Crane, Roger S. Payne, Richard L. Penney, Fernando Not tebohm, George Schaller, Thomas T. Struhsaker, C. Ala Lill, O. Marcus Buchanan, *Resident Director, Willia Beebe Tropical Research Station.*

GENERA

Walter Lerchenfeld, *Comptroller;* John McKew, *Personne Manager & Assistant to the Director, Zoological Park* Gordon Cuyler, *Membership Chairman & Administrativ Associate;* Jerry M. Johnson, *Curator, Department of Ex hibition and Graphic Arts;* Edward R. Ricciuti, *Editor Associate Curator, Publications;* Elysbeth H. Wyckoff *Production Editor;* Dorothy Reville, *Photo Librarian* Sam Dunton, *Phtographer.*

AFFILIAT

Jackson Hole Biological Research Statio
L. Floyd Clarke, *Directo*

animal kingdom

MAGAZINE OF THE NEW YORK ZOOLOGICAL SOCIETY VOL. LXX NO. 6 DECEMBER, 1967

ABOUT THE COVER

Stately and serene, the American egret stalks the shallows of the Everglades in quest of frogs and fish. The egret, like other "glades" wildlife, is captive of a complex ecological system, one of the most interesting on the North American continent. In this issue, Florida conservationist William Partington writes about the ecology and wildlife of the Everglades in the second of a two-part series.

CONTENTS

THE EVERGLADES: ECOLOGICAL PUZZLE Part II 162
by William M. Partington

HYENAS: FACTS AND FANCY 173
by Patricia O'Connor

SHARK ATTACKS 180
by William J. Cromie

CAMERA SAFARI 186
by Elysbeth Wyckoff

ANIMAL KINGDOM REPORTS 190

THE BOOKSHELF 192

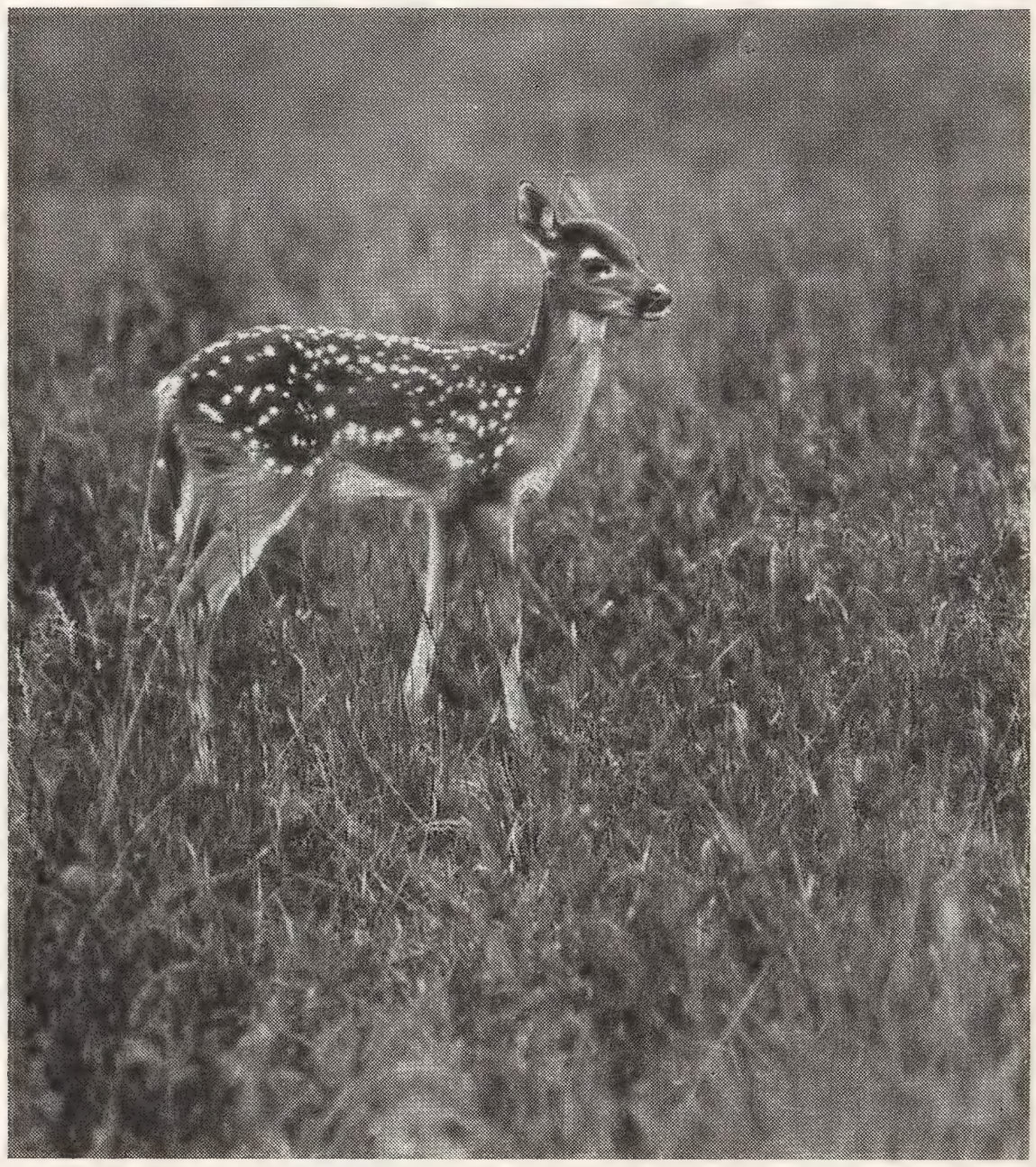
ABOUT THE AUTHORS 192

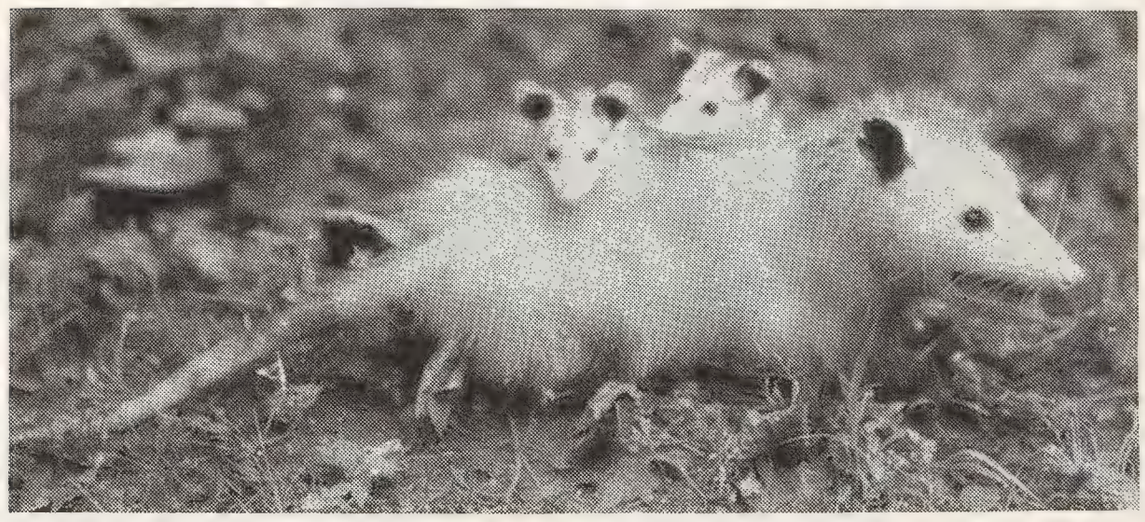
ILLUSTRATION CREDITS 192

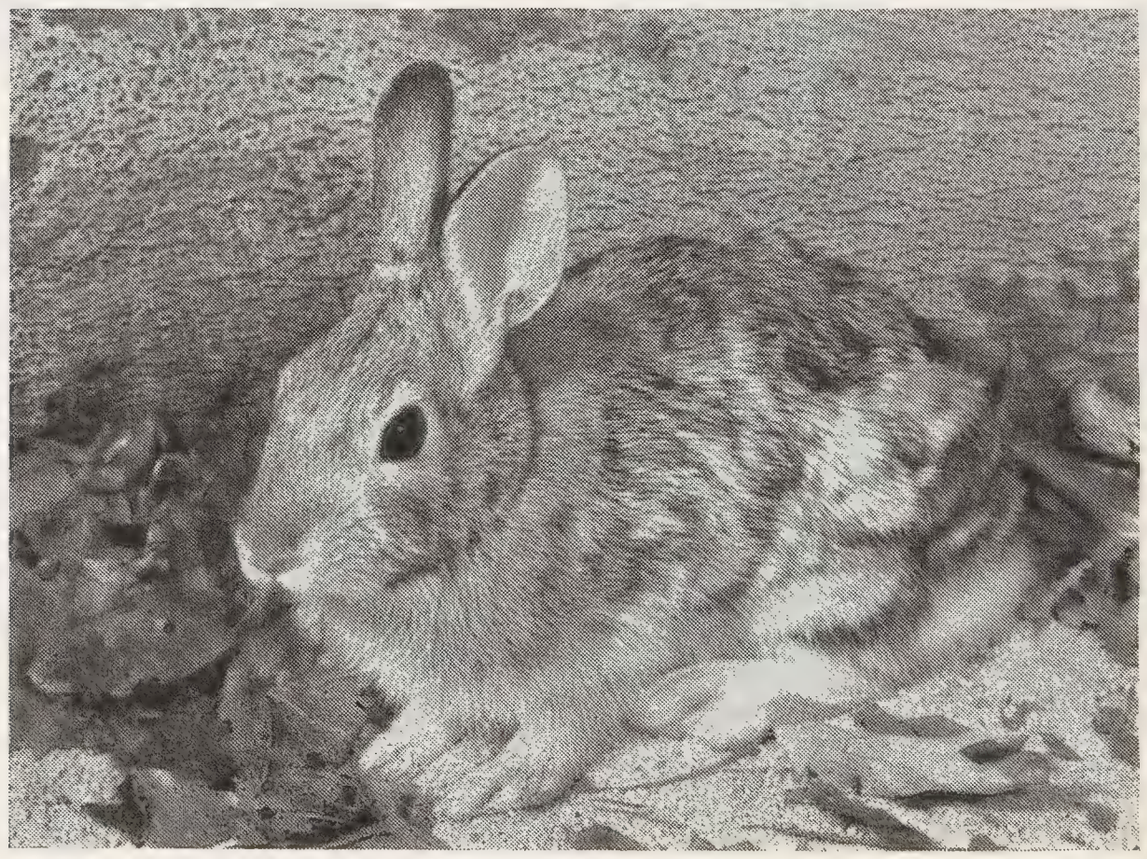
The Everglades: Ecological Puzzle

PART II

by William M. Partington







The black-crowned night heron, one of the many birds of the Everglades, nests in colonies which are often quite large.

The lush Everglades landscape, hauntingly beautiful, is unique in the United States. Nevertheless, it is very doubtful that nationwide concern would have reached its present zenith over droughts and floods in this region were it not for the effects of climactic events on Florida's wildlife. Statistics on rainfall, acre-feet of water, underground aquifers, and appropriations for public works make dull reading. But, as one seasoned Everglades guide said, "If you want to catch the public's eye, write about sex or run a photo of a 'gator."

The Everglades provides a habitat for a mixture of animals found nowhere else in the United States and yet contains elements that came from everywhere. Raccoons, bears, panthers (pumas), otters, and opossums arrived in south Florida from other parts of the country. Many birds, reptiles, amphibians, and freshwater fish are also northern species, although through the thousands of years of relative isolation from breeding stocks to the north, separate subspecies have developed in the southern end of the state.

A few West Indian vertebrates have also established themselves in south Florida's rich variety of subtropical plant communities. Some, such as the ani and mangrove cuckoo, have flown in; others have been "rafted" in on floating material—reef geckos for example. Modern rafts in the form of steamships have brought small geckos and anoles from the Antilles, and the Mediterranean gecko has jumped ship in warmer ports the world over, including Key West and Miami. The armadillo is another probable "escapee" that is now well established in the drier parts of the state. The brown water snake appears to have been helped in its movement to the lower part of the state by means of the system of canals constructed in the last 60 years, an unintended side effect of early land-reclamation projects.

Although individual animals may be very perishable, whole populations tend to be rather durable and resistant to temporary setbacks such as droughts, fires, hurricanes, and flooding. Some hopeful recoveries have been made by various species in the last year, although droughts and shortages of overland water flow in previous years caused justifiable national concern over their dwindling numbers.

The wood ibis, well known as our only native stork, is under careful study by Dr. William B. Robertson, Jr., research biologist

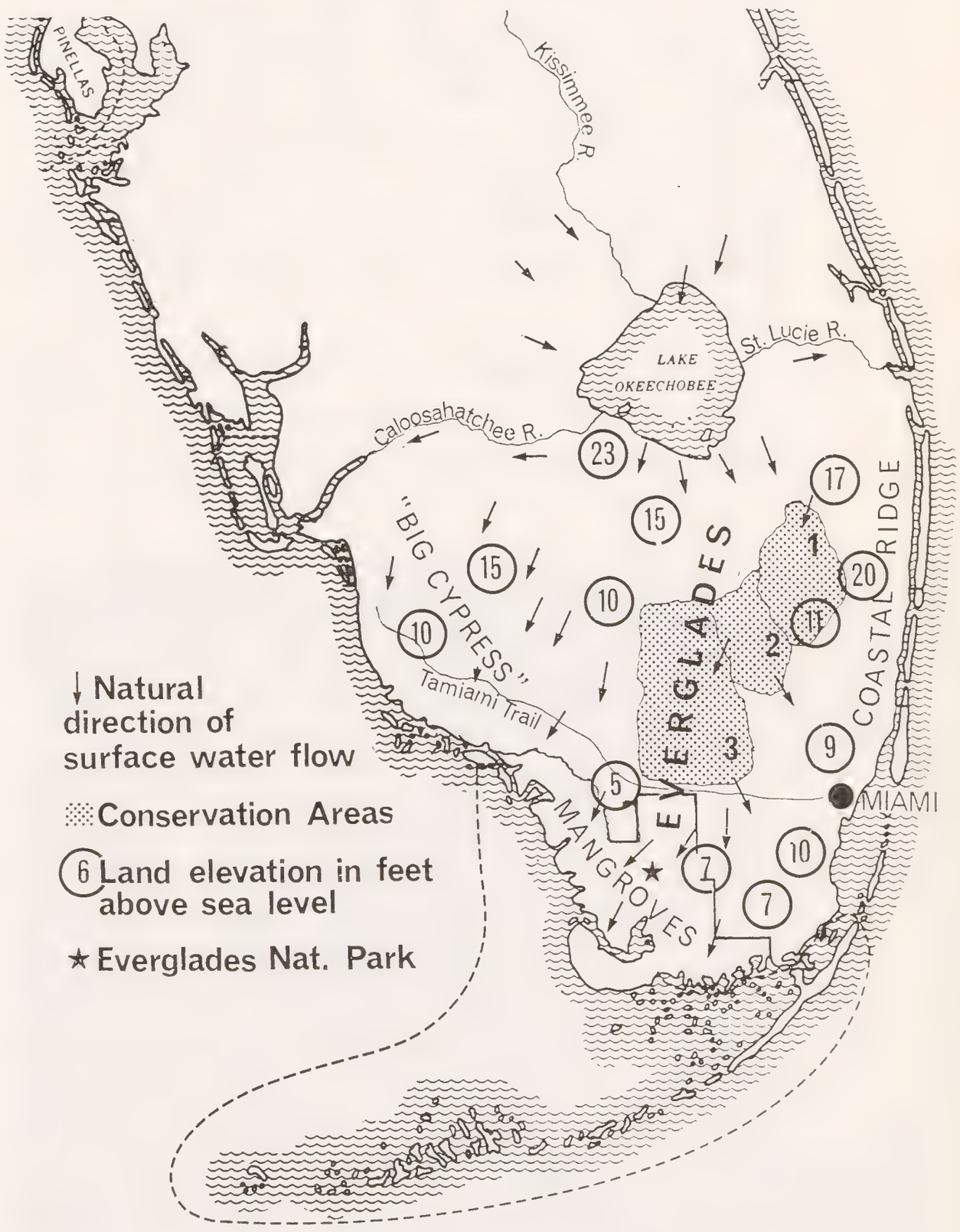
of the Everglades National Park, as an indicator of the ecological well-being of Everglades freshwater marshes. This species was not extensively reduced by the infamous plume hunters of the turn of the century, as were the egrets, and until recently it occurred in large numbers. Because of loss of suitable habitats in other parts of the state, the wood ibis' most significant nesting sites are now in south Florida, including Corkscrew Swamp and the Everglades National Park.

The wood ibis nests in colonies rather than individually, as, for example, do the few remaining reddish egrets. When feeding, wood ibis usually stay in groups, groping in the water for the immense amount of fish and frogs needed for themselves and their young. On flights to distant feeding areas they ride thermal air currents that rise over the land, avoiding open water wherever possible. Consequently the wood ibis are confined mostly to the mainland, where they can be studied with relative ease, even though suitable feeding ponds are available on some of the Keys in Florida Bay.

Although the droughts of 1961–1965 virtually eliminated all successful nesting of the wood ibis in the park, some were reared during 1963–1965 in Corkscrew Swamp and in satellite colonies scattered through what remains of the Big Cypress Swamp of southwest Florida. Only a few thousand of Florida's estimated original population of 100,000 wood ibis remain. Heavy spring and summer rains of 1966, plus increased discharges from water impoundment areas by the Corps of Engineers of close to a million acre-feet of water into the north end of the park, caused an increase of aquatic food organisms, and in the winter and spring of 1966–1967 several thousand young wood ibis were raised successfully in the park, for the first time in six years. This spring's drought came too late to hurt them during the early part of the nesting period, when the parents must remain close to the young to guard and feed them. Later, when the young wood ibis were larger, the nearby ponds dried out and the adults traveled 50 miles each way to the southeast end of Conservation Area 3, one of the water impoundment areas outside the park where some water remained. This hardship doubtlessly caused some adult and juvenile mortality. Area 3 has never held water satisfactorily, and there is some argument that if that water had flowed into the park, as it had before construction of the Tamiami Trail in 1928, useful feeding pools would have been available for the wood ibis at half the distance. In any event luck played a large part in producing a good crop of storks—less overland water flow in 1966 followed by a drier winter would have once again caused disaster.

Since the wood ibis usually matures in three years, the total population may drop until this year's young mature. Ornithologists cannot tell what will happen when these birds venture north in the summer to seek other feeding grounds, but as water control agencies become increasingly aware of the values and public concern over wildlife, the outlook seems at

Direction of water flow within the conservation areas.



least more hopeful for the wood ibis in south Florida.

How did other wading birds fare this season? The last enormous nestings of egrets, herons, and white ibis in the Shark River Rookery took place in the early 1940s, and there were about one quarter of a million birds in 1945. Since then a maximum of 15,000 birds have nested there in wet years, but none nested there in less favorable times. This past spring more common egrets and white ibis successfully nested in this rich estuary than in any year since the park's 1947 opening. The birds were undoubtedly assisted by the upsurge of aquatic food resulting from increased overland water flow through the Shark River Slough in 1966. However, snowy egrets and Louisiana herons were late in nesting due to this spring's drought. By the time these birds were raising young, high water had dispersed whatever food existed, and many young birds were deserted in the nests, another demonstration of the complex problem of finding the ideal solution for Everglades water birds.

Florida cannot boast of such a magnificent rarity as the whooping crane, but it does provide a home for one species of bird that is at least twice as rare: the Everglade kite. Approximately 20 of these remain, most of which nest in Conservation Area 2, west of Pompano Beach.

Richard Thompson, manager of the Loxahatchee Wildlife Refuge, where the kites nested for several years, has closely studied these small hawks, but is quick to admit that their survival is uncertain. Many observers fix the blame on the disappearing habitat of the kite's favored food item, the apple snail, *Pomacea paludosa*. However, this snail is common in almost every canal and slough of Florida.

Droughts in the conservation areas cause apple snails to aestivate by burrowing beyond reach of the kites. The birds then must find new feeding places and occasionally show up at the north end of the Everglades National Park, at Fisheating Creek, or at other remote spots.

Parasites and diseases transmitted by snails may also pose a danger to the kites, especially since these birds are rather colonial in their feeding habits and thus might be prone to the spread of infection.

Fair numbers of Everglade kites originally lived in marshes as far north as Wakulla Springs and the upper St. Johns Valley, but land development and hunters reduced those populations below the recovery point. Most of the survivors living around Lake Okeechobee moved to a safer habitat in Conservation Area 1 in the 1950s. After 1964, Area 1 became too dry and the kites moved south again to Area 2, where there is a more stable water supply. They have nested there since.

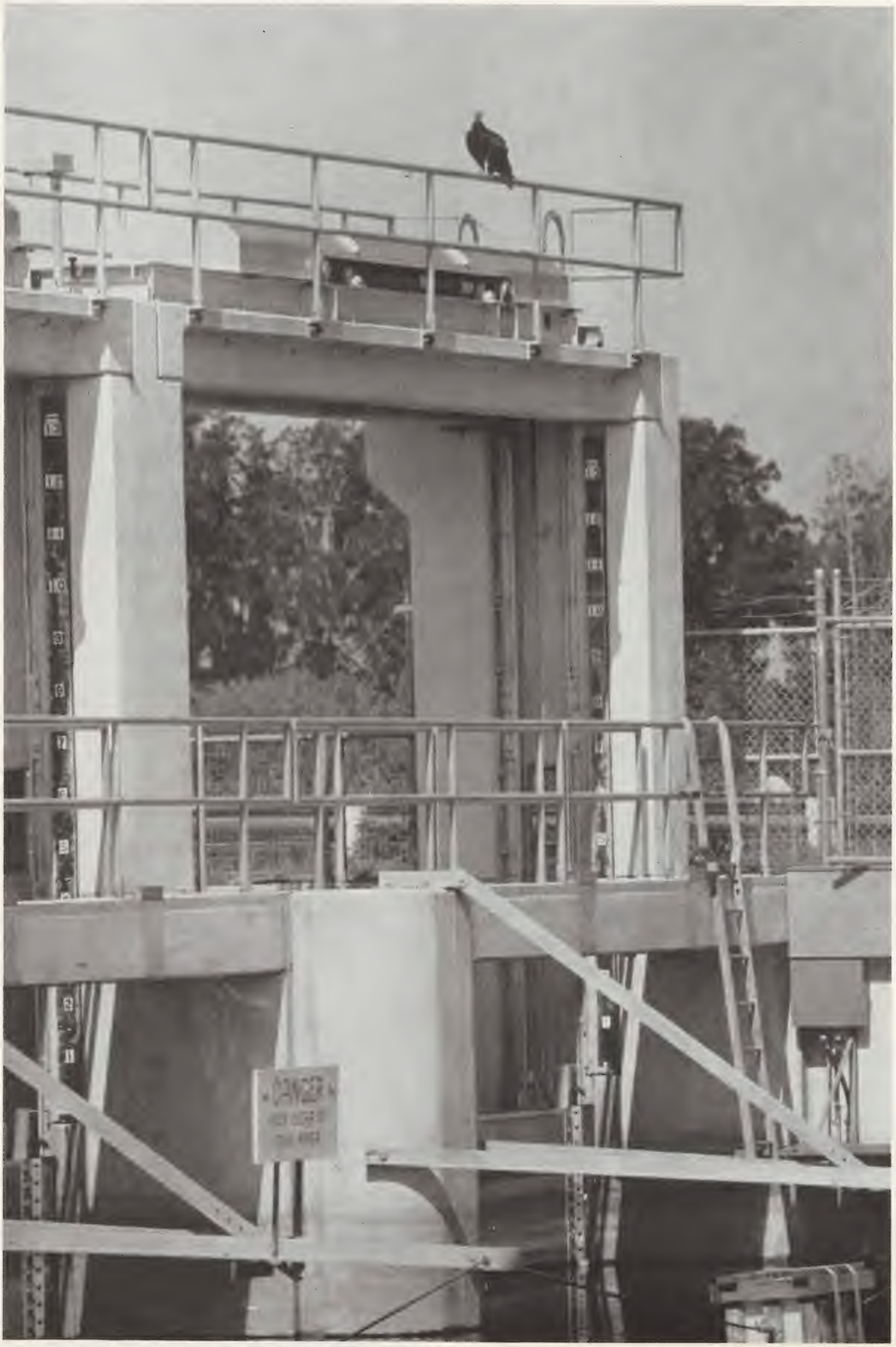
Area 2, however, was almost a disastrous choice. In mid-May an awesome sawgrass fire with a 10-mile front spread through the northeast section to the edge of the area of tree islands and sloughs where the kites had nested. Although water covered the ground at the time, the exposed grass burned rapidly out of control. Luckily the kites had finished nesting and as far as anyone knows were not directly harmed.

Even "natural" disasters may be fatal for this unique subspecies, and unless immediate steps are taken to carefully manage their chosen habitat, the Everglade kite can be expected to disappear forever.

To go to another zoological extreme, let's look at south Florida's 50 varieties of the tree snails, *Liguus fasciatus*, some of which are endemic to only a few hammocks. The "ligs" are arboreal and depend on heavy dew or sufficient rainfall. The eggs and buttons (babies up to a year old) are especially susceptible to drought, whereas the main enemies of the adults are collectors or real estate developers. Erwin C. Winte, a Tamiami subdistrict ranger who has been with the park from the start, has made a special attempt to study and save the snails from extinction. Luckily there was dew almost every morning during the spring drought and Winte attributes the favorable survival of the snails to this.

Changes in reptile and amphibian populations were certainly noticeable during this drought. Dry or wet periods in Florida have a greater effect on observable numbers of animals than do seasonal changes. In June 1966, an American Society of Ichthyologists and

Above: Members of the Florida Game & Fresh Water Fish Commission bring in an 11-foot alligator to be tagged. Left: Commission members prepare to tape alligator's mouth before tagging and measuring. Lower left: With assistance from the fire warden of the National Park Service, the alligator, caught at Shark Valley Loop Road, is turned over for measurement. Lower right: A small five-foot alligator is untied after being tagged. The value of the alligator, especially during drought, has been greatly underestimated. Some 'gator holes have underground tunnels or a pit in the deepest part and are the last places to hold water during dry periods. At this time these holes serve as a source of water for terrestrial animals and a survival area for many of the fish, amphibians, and aquatic invertebrates of the Everglades and the Everglades National Park.



Much of the water to the Everglades National Park flows through spillway #12C. One million acre-feet of water was released through such structures last year.

Herpetologists field trip went to a favorite collecting area for reptiles north of the Everglades National Park known as Loop Road. (It is also suspected that Loop Road is a favorite habitat for poachers and others who have more reason for living away from civilization than their enjoyment of the beauty of nature.) Loop Road passes through a variety of habitats: willow swamps, hammocks, sloughs, cypress, sawgrass, and pine flatwoods, and just driving along the road is often productive for reptile collectors.

The ASIH trip was organized by Dr. F. Wayne King, now associate curator of reptiles at the New York Zoological Park, and Tom Krakauer, a graduate student at the University of Florida. About 50 notable zoo curators and keepers, researchers, and students probed the bushes and seined the ponds. The water was high and at night numerous breeding choruses of green and squirrel tree frogs could be found. Southern bullfrogs croaked in the canals and Florida cricket frogs clicked at the edges of the shallower pools.

The roadside seemed to act as a favorable ecotone for numerous king snakes, ribbon snakes, and racers. Only one Florida water snake was found and only one rat snake, but it was something of a prize.

Less than a year afterward, in April 1967, the same area was almost bone dry. Even the *Tillandsia* airplants and *Epidendron* orchids

Air boat, a main mode of transportation in the Everglades, skims over surface of water and sawgrass. Raised propeller enables boat to avoid tangles of undergrowth.

Turkey vultures gather near spillway #12C. Conservation Area 3 lies beyond.

hanging from the cypress looked gray and dusty, with no water trapped in their leaf bases, a favorite hiding place for tree frogs. The only reptiles found were around drying water holes where culverts cut underneath the road. Here Florida water snakes, green water snakes, and cottonmouths gathered to feast on trapped catfish and mudfish. There was at least a month of drought yet to go, and these food supplies must have disappeared quickly. One can guess the outcome—of these three snakes, only the cottonmouth is a confirmed snake eater, and healthy specimens have frequently been found in dried swamps where the only other signs of reptiles were peeling, empty shells of striped mud turtles.

It could be said that the seriousness of this year's drought depended on what you looked at or where you were. Fish, particularly bass, were among the most affected vertebrates, as the water dropped, trophy-sized largemouths died at the height of their spawning season

The eastern brown pelican can be seen diving for fish throughout the glades.

and floated on the warm surface of pools and ponds. Lower water levels in the perimeter canals around Conservation Area 1 promoted a "bloom" of blue-green algae, and the State Game and Fish Commission removed all daily limits on fishing because few valuable fish were expected to survive in the oxygen-poor water. As ponds and sloughs in the glades dried out, a sickening tangle of mudfish and garfish flopped pathetically through the hot, oily looking mud.

Other aquatic animals were more successful. While digging a pond in a dry marsh of swamp fern and redroot we found Florida mud turtles dormant and somewhat desiccated in the peaty upper layer of soil. Another discovery was a female amphiuma, a black eel-like amphibian with four tiny legs, curled about her 40-odd eggs. The embryos were fully developed and when dropped into water they started wiggling within the egg, and hatched within three hours.

Even though some of the more spectacular forms of wildlife seem to be doing well in the Everglades after this past season, the public should not lose sight of what is happening to this natural wonderland. In the "old days" when various animals suffered severe drawbacks in the glades, populations of the same species in other parts of their range could be tapped for restocking. Nowadays these other populations are often very slender, if not defunct, as a result of land reclamation for farming, cattle, housing developments, roads, airports, and navigational projects. The Everglades, including Everglades National Park, Corkscrew Swamp, and the three conservation areas managed by the Flood Control District (FCD), become ever more precious as a significant wildlife breeding and feeding area, and correct management becomes ever more important.

Heavy seasonal rainfall alone cannot be expected to keep the Everglades system healthy. Dr. Robertson has noted that at least 300,000 acre-feet of water must flow overland into the park during the rainy season for the wood ibis to rear their young successfully, and this figure is probably about right for most other water birds and such park specialties as panther, bear, mink, and otter, which feed on aquatic life to varying extents. The minimum requirement should be raised considerably if preceding years had been dry. There can be no doubt that the Everglades National Park needs assurances of overland water flow if it is to remain a unique national asset. Droughts, fires, and floods are historical hazards in the glades, but in the future they must be controlled with exact knowledge of their effects on the ecology and wildlife, and this will require the sincere cooperation of federal and state agencies of diverse purposes.

The conservation areas continue to be a subject of concern. Conservationists, joined by hunters, have repeatedly requested the FCD to protect the areas from encroachment by private enterprise. The conservation areas are valuable to the Everglades system as feeding grounds for many of the park's birds and as habitats for the Everglade kite. Few people would like to see the conservation areas permanently drowned and simply thought of as water storage areas, even if this were possible. Area 3, for instance, is located on porous limestone and does not hold high water levels satisfactorily during dry periods, in fact, the deeper the water is stored, the faster it seeps out or dries up.

In 1966 high water filled Area 3 for the first time since 1962 when the encircling levees were finished that exhausted and drowned hundreds of deer and fawns. Even raised alligator nests were drowned out. This became something of a nationwide (and international) sensation. Local airboat hunters tried to move as many deer as possible to drier land north of Area 3, and tempers flared between formerly friendly groups of hunters, the game commission, and the FCD. The FCD Board recently voted to investigate means of releasing water from Area 3 in the park during periods of high water by constructing culverts underneath the Tamiami Trail.

At one point it was feared that the old Miami Canal through Area 3 was going to be enlarged to direct water to the park. The Army Engineers are digging another canal parallel to and west of the Miami Canal. Hopefully this will not disturb the wildlife that has established itself in the old overgrown "mud canal."

A subtle threat to native wilderness is an exotic ornamental tree, the melaleuca, which now grows wild all over south Florida. Along the south coast it has infiltrated cypress swamps, displacing the native trees, a process that seems to accelerate drying of the swamps.

It has been said that each generation must solve its own conservation problems, but these problems sprout like dragons' teeth in south Florida. Local and national articles on the Everglades have aroused public concern over the plans of the massive water project agencies capable of assisting or killing this vast ecosystem. In response to public awareness, interagency cooperation is becoming the order of the day, and the future looks somewhat more hopeful for the Everglades. As one wildlife officer said after rains had broken the spring drought at its critical point, "Now I feel as carefree as the wildlife."

But let's not stop being concerned.

PATRICIA O'CONNOR

Hyenas: facts and fancy

Some people like to brag that they have a "cast iron" stomach and can eat and easily digest any amount of questionable or unsavory combinations of foods with impunity. But these same people would quail before the bill of fare that a hyena eats with relish. With its powerful jaws and specially constructed teeth, it will shear through the thigh bone of an ox and enjoy the splinters that result. This animal habitually consumes a variety of seemingly indigestible and distasteful substances. To vary its hodge-podge diet, it may seize an old dried-out hide or a pair of worn-out boots or even a leather saddle and masticate such material with as much enthusiasm as a schoolboy chewing gum. The main food of hyenas, however, is carrion and offal, regardless of its state of putrefaction, and hyenas not only eat the

flesh and entrails but will swallow a whole knuckle bone without a single crunch.

A hyena will rarely attack a living animal unless it is dying, but it follows wounded animals patiently, waiting for them to die.* In the Hottentot country hyenas have been known to dig up the remains of the dead which have been buried in shallow graves, and some of the Masai tribes still deliberately put out their dead for the hyenas to dispose of. In 1908 and 1909, when Uganda was scourged by sleeping sickness, hyenas became so emboldened by the regular supply of corpses, they began to raid native villages, graduating from corpses to the sick and helpless and eventually to healthy people.

While hunters and natives dislike the hyena, they fail to appreciate its important role as a public benefactor. At night it enters the unlighted villages in search of offal which has been thrown into the streets, swallowing any and all forms of decaying material. Thus this animal's industrious scavenging habits are truly prophylactic, ridding the community of its noxious refuse. In many areas, the hyenas and vultures combine as a sanitary squad, with the hyenas cleaning up at night and the vultures taking the day shift.

Female hyenas are polyoestrus, that is, will breed at any time of the year. The gestation period is 90 to 112 days and the pups (usually two to four) are born with their eyes open. It is necessary to remove the male before the birth of the young to prevent him from devouring them.

In 1961, Dr. Nieboer of the Amsterdam Zoo hand-reared one striped and two spotted hyenas on a formula of fresh cow's milk, cream, raw eggs, and vitamin concentrates. In spite of their unsavory reputation, hand-reared hyenas, under favorable conditions, may remain perfectly tame after they become fully adult.

Once widespread throughout Europe, Asia to eastern China, and all of Africa, hyenas are today restricted to Africa, India, and the Near East. Three species are known, two of which belong to the genus *Hyaena,* while the other is *Crocuta.* The striped hyena, *Hyaena hyaena,* has the widest distribution, being found in India, Persia, and Asia Minor. The spotted form, *Crocuta crocuta,* occurs in North Africa with a southern limit in Senegal and Nigeria, and in a great part of East Africa and western Asia from the Mediterranean to Bengal. In Abyssinia they are found at heights up to 12,000 feet. The range of the brown hyena, *Hyaena brunnea,* is confined to the coast regions of South Africa, where it is known as the "strand wolf." This species is unusually plentiful in the Gobabis district in eastern Damaraland.

The striped hyena is a nocturnal and rather solitary animal, rarely prowling about in numbers of more than two. Its three-foot-long body is covered with long, coarse, grayish-brown hair with blackish stripes running along the ribs, legs, and short bushy tail. A large, black patch extends over the front of the throat. In the young the stripes are much more pronounced than in the adult. The long, wiry hairs on the back of the neck form a sort of reverse mane. In all three species the powerful forelegs are tremendously well developed, in marked con-

* Editor's note: Recent field research in Africa's Serengeti plains indicates that hyenas are not only scavengers but keen hunters, stalking zebra, wildebeest, and other game in packs by night.

The striped hyena has long grayish-brown hair with blackish stripes which are more pronounced in the young than in the adult. A black patch extends over the front of the throat.

trast to the short, weak hind legs. Thus the line of the back slopes downward from the shoulders, giving the animal the appearance of the combined halves of two different creatures.

The hyena's broad head has short rounded ears and a dog like muzzle. The surface of the tongue is rough and thorn-studded like that of a tiger. The jaw muscles are as powerful as those of a lion three times its weight, and some of the molar teeth have three cutting edges.

Each of the feet has only four toes and the inside toe is smaller than the outside one, so the footmarks can easily be distinguished from those of dogs. The claws are blunted and are not retractile. Yet in spite of its awkward slouching gait, the hyena can run surprisingly fast and has been clocked at 40 miles per hour. If it cannot find a hideout of brush, the hyena goes underground during the daylight hours. However, it doesn't dig a hole but waits for a warthog to vacate one and then backs into the hole, hind feet first.

The more aggressive spotted hyena is the largest of the three species. The male attains a body length of more than four feet, stands nearly three feet high, and weighs 150 pounds or more. Its shaggy, yellowish-brown fur is coarse and rather long and distinguished by numerous well-defined spots or blotches. There is no mane on its back and the tail is short-haired. Young specimens are devoid of spots, which is in marked contrast to the young of African lions, which are born with spots that gradually fade out as the animals mature.

Spotted hyenas are famous for the strange unearthly sounds they utter under strong excitement. This species is often referred to as the "laughing hyena" because of the hysterical-sounding laugh which it pours forth accompanied by the most absurd gestures of the body and limbs.

The brown hyena gets its name from its dark-brown, long-haired coat. This species has stripes only on its legs.

It is almost impossible to distinguish the female spotted hyena from the male by a mere inspection of the external sexual organs, which appear to be almost identical. This fact may serve to explain the idea common among the ancient Greeks that these animals were hermaphroditic. Aristotle (384 B.C.) appears to have been first to investigate the genital anatomy of the hyena and took great pains to show the absurdity of this belief. Pliny wrote that "it is a matter of common belief that the hyena is bisexual, that it is male and female on alternate years." This misconception still exists at the present time among the Boers of Africa who believe that the male animal nurses the young. It is interesting to speculate on how in the course of evolution among three so closely allied species, two should have conformed to the normal mammalian type in every particular, while the third diverged so remarkably in respect to the structural configuration of a single group of organs. The cerebral arterial system of the striped hyena shows many differences from other Carnivora.

The spotted hyena, largest of the three species, is distinguished by numerous well-defined spots or blotches. These hyenas are known for their strange "laughing" sounds.

The third species, *Hyaena brunnea,* has a dark-brown, long-haired coat which hangs down over its back like a cloak. There are transverse stripes on the legs but not on the body. In habits it more closely resembles its striped relative; it is a comparatively silent animal and generally considered to do little damage to livestock.

The mythology and native superstition associated with the hyena is rampant with incredible beliefs. The ancients believed that this animal was accustomed to decoying stray travelers to its den by imitating the laughter of human revelers then killing and devouring the wayfarers. Besides the ordinary teeth with which the hyena is endowed, ancient authors described two additional rows of teeth in each jaw and a supply of darts at the end of the tail. After the animal's death its eyes were believed to turn to stone.

Young spotted hyenas are devoid of spots and are black in color. Their weaning period is exceptionally long.

In Sennar, a province of the Egyptian Sudan, members of the Hammez and Fungi tribes enjoy the reputations of being powerful magicians who can turn themselves into hyenas at night and in this guise scour the countryside howling and gorging themselves. But by day they again become men, and thus it is very dangerous to shoot such human hyenas without invoking serious consequences. In Abyssinian folklore, where all iron workers are considered outcasts, blacksmiths are supposed to turn into hyenas and commit horrible depredations in that shape.

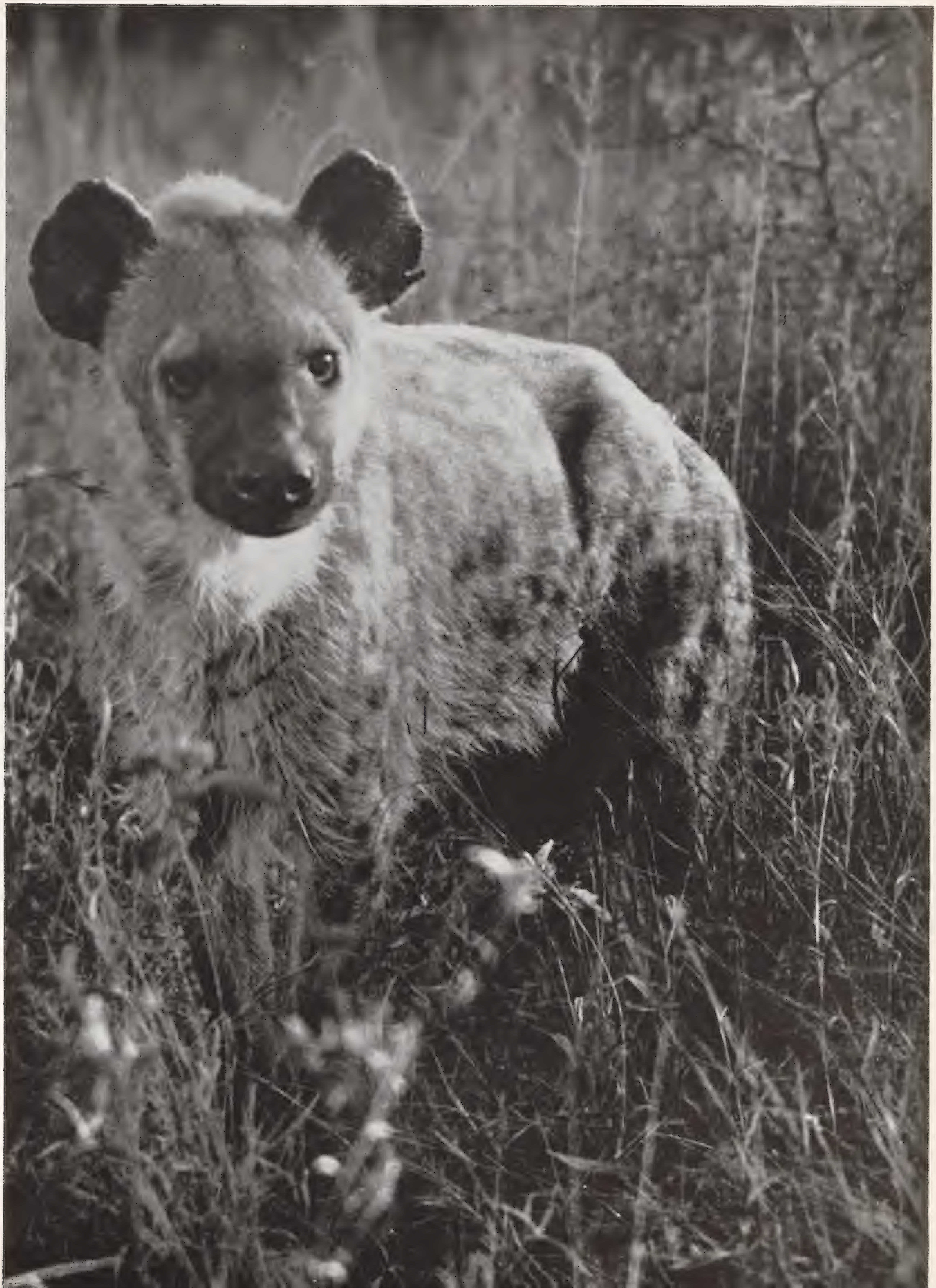
Among the African myths on the origin of death is one which holds that hyenas possess a magic staff called a "kirasa" with which they can recall the dead to life. Then after questioning the revived men as to the manner of their deaths, the hyenas will eat them.

Totemism seems to have existed over all of Africa south of the Sahara. In some places it persists in an unmistakable form, but more often it survives in a form no longer understood, or only partly so by the people themselves. The Nandi tribe has a hyena clan which has some curious privileges and is very highly esteemed. However, the hyena is esteemed by all Nandi, not merely those whose totem he is, and is also the object of what might be called a cult. Among the Geryama and other tribes, witchcraft occupies a prominent place. Witches are believed to have a power over certain animals which they employ as their messengers. Hyenas are commonly sent by them to open graves for cannibal feasts.

At least one of the Christianized tribes of Africa, the Bechwanas, esteem the hyena's flesh as a delicacy and are especially keen to get the heart, believing that it will bring them courage. They believe that medicine made from the bones of the hyena, if caught when the moon is in Gemini, will cure bleared eyes, rheumatism, lumbago, and mad dogs.

Long a subject of spurious tall tales, the hyena fills a valuable niche in the ecological ladder—and is an interesting member of the animal kingdom.

Spotted hyena, Kruger National Park, South Africa.



Shark Attacks

By WILLIAM J. CROMIE

This article was adapted from the book Living World of the Sea, *Prentice-Hall, Inc., by the author.*

Hans Fix was fishing in waist-deep water off Padre Island, Texas, when he suddenly felt a searing pain in his right leg. Formerly an officer in the Germany Navy, Fix knew immediately what had happened. The Sunday outing with

his family was about to turn into a life-or-death struggle.

The 48-year-old cotton gin worker looked down and saw an eight-foot shark gliding away through water turning red with blood. Fix knew the fish would be back. He yelled to his wife and five children on the beach and started toward them.

The shark made a wide, sweeping turn and attacked again. Fix tried to beat the animal off with his fishing rod, slamming the butt down on the tooth-filled snout as hard as he could. But the shark ripped him twice more.

Fix yelled for help but bystanders were afraid to go into the water they later described as "boiling with sharks." Finally two men

waded out and carried Fix back to shore. His leg had been nearly severed.

Robert J. Lauer of McAllen, Texas, put a tourniquet on Fix's thigh, and an ambulance rushed him to a hospital. But it was too late. Hans Fix died from loss of blood about 30 minutes after the attack on August 19, 1962.

According to the Shark Research Panel of the American Institute of Biological Sciences, sharks have launched some 990 unprovoked attacks on humans in the past 20 years, but undoubtedly many other cases have gone unreported. There were 41 known attacks in 1966.

During the past 50 years there have been more than 200 attacks off North American beaches, of which 70 were fatal. In the 11 attacks in North American waters last year, none of the victims died.

What makes a shark attack a human? Dr. Stewart Springer of the U. S. Fish and Wildlife Service believes that many attacks are made by rogue sharks or "bank loafers," solitary individuals that become separated from the main concentration of their fellows and wander into shallow water.

Dr. V. M. Coppelson, an Australian authority who has been studying sharks' activities since 1919, says that once sharks have dined on human flesh they may acquire a taste for it.

Scientists are studying shark behavior and physiology and the circumstances of attacks to find better answers. But for all the efforts of science, sharks remain cloaked in mystery and misinformation. They are portrayed at once as fearless killers and bullying cowards, as aggressive predators and dull-witted, self-propelled garbage cans.

This formidable beast comes in 250 varieties, of which about 30 have been caught in the act of attacking people. Most of the attacks have occurred in warm tropical and subtropical seas, but sharks have assaulted people as far upriver as 150 miles. One species (*Carcharhinus leucas*), common in mid-Atlantic coastal areas, enters fresh water. By traveling upriver, it has gained entrance to a Nicaraguan lake, where it has killed a number of bathers.

Sharks are famous for their ravenous appetites and catholic diets. Most of them prefer fresh, oily fish, but they have been seen eating squid, seals, seabirds, other sharks, turtles, lobsters, garbage, humans, and, in one case, a crazed elephant that ran into the sea.

Porpoises, tuna, and other marine animals that outswim sharks are attacked when they are disabled, dying, or too young to fend for themselves. In addition, the stomachs of captured sharks have given up grass, wooden crates, tin cans, a sack of coal, the skull of a cow, the hindquarters of a pig, and the front half of a bulldog.

Although they have four to six rows of saw-edged, razor-sharp teeth, sharks bite and swallow without bothering to chew. They sometimes store food in their stomachs for days without digesting it.

In most sharks, the mouth lies well back on the underside of the head, and is ideal for grabbing flounders and lobsters off the ocean floor —and has led to the old belief that sharks must turn on their backs or sides to bite. But when a shark attacks, it comes up from below, angling its snout upward so the mouth can slide over the prey. Its powerful jaws snap shut, and the shark shakes violently from side to side, tearing loose as much as 10 or 15 pounds of flesh. In attacks such as the one on Hans Fix, a major artery frequently is severed and the victim bleeds to death.

A shark detects its next meal by using a long-distance "feeling" mechanism. Underwater waves or low-frequency vibrations set up by a man or animal as it moves through the water can be picked up as far away as 600 feet by nerve endings in a pore-punctured canal (lateral line) extending along the shark's side. This streamlined ocean-going bloodhound also has one of the keenest senses of smell in the sea. A shark can sniff out an ounce of blood in millions of gallons of water, and detect a scent a quarter-mile from its source.

Smell, however, is useless when a shark is upcurrent from a source of blood. A shark starts using its eyes when it is between 10 and 50 feet away from a victim. The eyes are ex-

Lemon sharks, often reaching 11 feet in length, commonly frequent inshore waters.

cellently adapted for distinguishing contrasting colors or shades of color, even in dim light. The animal usually begins to circle slowly when about 10 feet away. After an inspecting pass or two, it may turn away indifferently or begin feeding.

Sharks cannot come to a sudden stop or back up. They swerve aside to avoid obstacles, and once their heads pass food they must circle back to take it. When attacking in a pack, sharks form tighter and tighter circles around their victim, swimming faster and faster until one moves in for the first bite.

Once blood or body juices flow into the water, sharks may go into a "feeding frenzy." Then nothing short of death stops them.

They bite anything that moves, and their whipping, thrashing bodies quickly churn the sea to a bloody froth. If a shark is accidentally bitten in the melee the pack devours their wounded mate with the same ferocity as they would another victim.

A blue shark, feeding in frenzy on a whale carcass, was caught by whalers, gutted, and flung back in the water. The blue went right on feeding and was caught again on a hook baited with its own intestines.

On the night of November 28, 1942, the British troopship *Nova Scotia,* carrying a load of Italian war prisoners, was torpedoed off the coast of South Africa. Sharks attacked the survivors while they floated in the water or struggled into lifeboats. A thousand men lost their lives, many of them to the sharks, which did their ghastly work in a feeding frenzy.

In 1944 the Navy issued a pamphlet, *Shark Sense,* claiming that practically all stories of man-eating sharks were fictitious. "There is practically no danger that an unwounded man floating in a life jacket will be attacked by a shark," it stated confidently. This pamphlet sparked a number of stories in the popular press, including one in a widely read national magazine that was titled "The Shark Is a Sissy."

Experts and amateurs have come up with a variety of devices to protect humans from the shark—poisons, electric shockers, noisemakers, wire fences, bubble screens, and even coordinated aircraft and ship raids. All have one thing in common—they don't work.

As a result of a crash program during World War II, the United States came up with a concoction optimistically called Shark Chaser. This repellent, the main ingredient of which is a dye, has prevented lone sharks from closing in on swimmers. It seems to repel most sharks if they are alone, not too hungry, and not in a feeding frenzy. However, Australian scientists, testing it on shark packs, were startled to find that not only did it not chase them, but the beasts ate it as fast as it was chucked into the water.

One of the standard gems of advice in survival manuals is that sharks can easily be frightened away by splashing and kicking. Experts now know that this is like ringing the dinner bell. To sharks, thrashing swimmers sound like wounded, struggling fish, and both could easily meet the same fate.

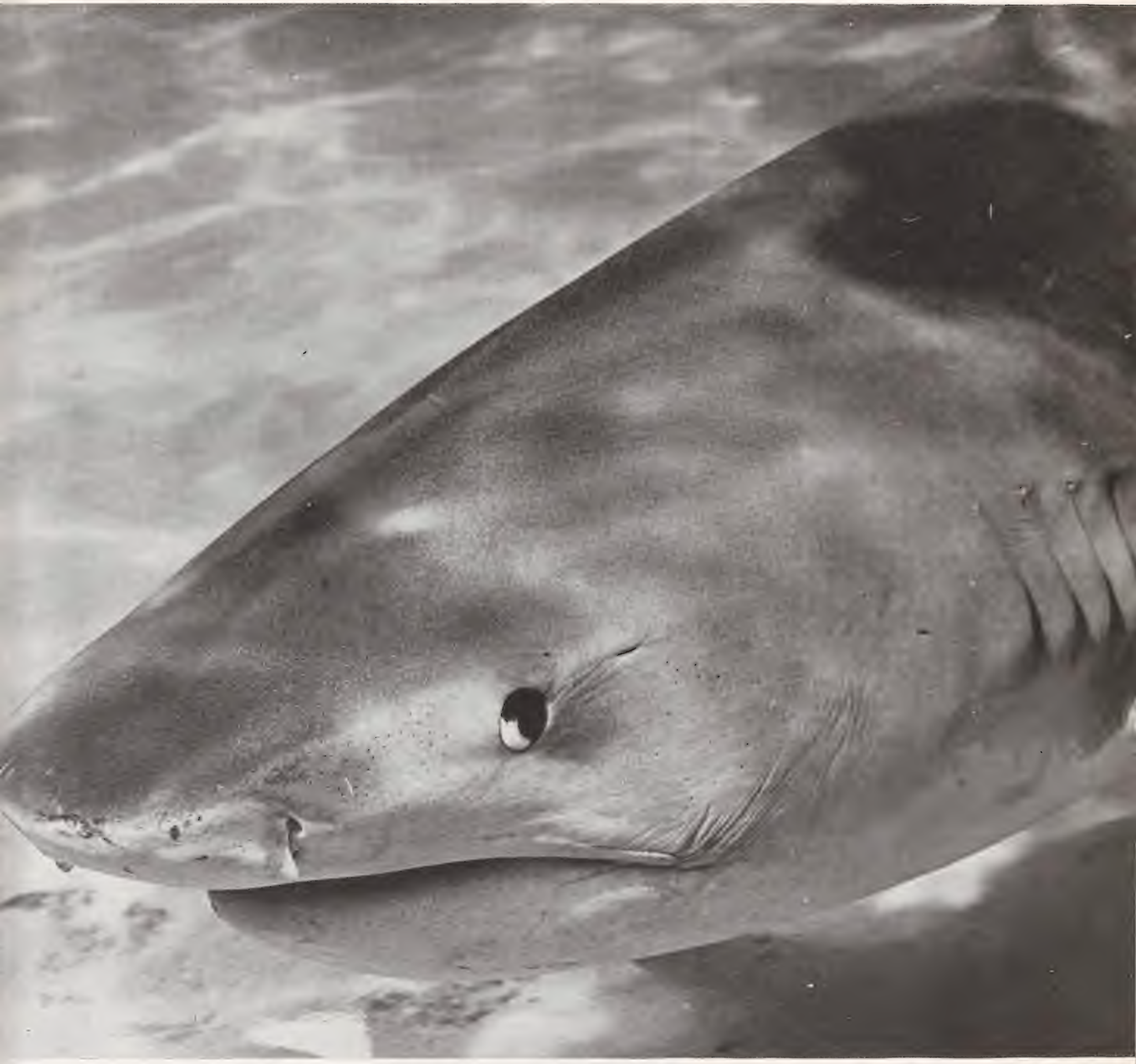
If you should come across a shark while swimming, the best thing to do is get out of the water as quickly and quietly as possible. Try not to panic. Swim with a rhythmic beat and make as little disturbance as possible. If you are wearing diving gear, swim underwater.

If a shark moves in on you, your best and only recourse is to fight back. Charge the shark and smash it on the snout with anything, if possible, but your fists. The sandpaper hide might cause bleeding, and blood will certainly spur the attack.

Never give up hope. A Navy pilot downed off Guadalcanal was attacked repeatedly by a shark. Each time, he hit it with his fists on the nose and eyes as hard as he could. Although severely wounded in the struggle, the pilot came out with his life and limbs.

To lessen the danger of attack, the Shark Research Panel of the American Institute of Biological Sciences offers the following advice:

- Always swim or dive with a companion.
- Don't swim or dive in the evening or at night when most species feed.
- If you receive a bleeding wound, get out of the water quickly.
- Remove speared fish from the water immediately. Do not carry them tied to your belt.



The voracious tiger shark will eat anything from tin cans to humans. Vertical bars along the sides have given this fish its name. Tiger sharks can reach a length of 18 feet and are a common fish in the Caribbean and other tropical waters.

- Don't trail arms or legs from a float or raft.
- Avoid bright or contrasting bathing suits and shiny jewelry.
- Never—never—tease, grab, spear, or try to ride even a small shark. The likelihood of shark attack is less than that of being struck by lightning, but the odds increase immensely if you deliberately provoke a shark.

CAMERA AS ART

Elysbeth Wyckoff

Herds of camels roam the deserts of North Africa. In this case they are being used for transportation to and from the Pyramids of Giza near Cairo, Egypt.

Japanese sika deer wander throughout Nara's Deer Park. The animals are tame and do not hesitate to give the visitor a slight nudge if he is slow in feeding them.

Anyone interested in animal photography will find an abundance of subjects on a trip to Asia and the Middle East. Zoos and parks in this part of the world are plentiful, often are well designed, and offer a variety of flora and fauna.

Deer Park in Nara, Japan, for instance, contains over 500 deer freely roaming amid the red torii, pagodas, and pine forests of the park. In the Zoological Gardens of Ceylon, animals in captivity also live in a most natural and attractive setting. Located a few miles from the capital, Colombo, this 42-acre zoo contains over 600 mammals, almost 1,500 birds, and more than 2,000 specimens of fish. Ceylon is green and lush, and the country's vibrant display of foliage is at its best within the Zoological Gardens.

In addition to the photographic possibilities at the parks and zoos, many animals can be seen functioning as part of the daily life of the major cities.

Bullock carts are a main mode of transporting goods in Colombo's marketplace, the Pettah. In Pakistan's capital, Karachi, camel-drawn carts share the streets with little three-wheeled, brightly decorated autos. Camels can also be seen in metropolitan Cairo and are a popular means of getting to the Pyramids. Sheep and goat herds wander along central boulevards, much to the chagrin of harried motorists. Such interesting juxtapositions as a herd of sheep being driven past a neon-encrusted cinema in the heart of Cairo make a camera safari to Asia and the Middle East a rewarding, though sometimes startling, experience.

The camera I used to take the adjacent photographs was a Konica. Prints were made from 35 mm. color slides.

African elephants are being bathed at the Zoological Gardens of Ceylon.

animal kingdom

NEWS OF ZOOS, AQUARIUMS, AND CONSERVATION

REPORTS

Striped diamondback

A rare form of western diamondback rattlesnake, marked with stripes instead of the customary diamond-shaped blotches, will soon be placed on exhibit at the Bronx Zoo.

The zoo obtained this unusual specimen from central Texas. Several years ago, two other striped diamondbacks were reported in the same area.

The western diamondback (*Crotalus atrox*) normally has a series of brown diamond-shaped splotches down the middle of the back. The diamonds are separated from the lighter ground color by black and then cream borders. Usually, the tail is alternately crossbanded with black and white.

The zoo's striped rattlesnake, however, has a wide dark brown band down the middle of its back. The dark band is separated from the brown of the snake's sides by a narrow yellow-brown stripe. The tail is gray-brown with black blotches.

Striped individuals are known to occur regularly in populations of two other blotched or ringed North American snakes, notes Dr. F. Wayne King, the zoo's associate curator of reptiles. These are the California kingsnake population found around San Diego, California, and the Pacific gopher snake in central California.

Dr. Osborn honored

Williams College, Williamstown, Mass., has awarded an honorary degree of Doctor of Humane Letters to Fairfield Osborn, president of the New York Zoological Society. The degree was awarded for Dr. Osborn's efforts to stimulate "awareness and concern over the future of man's physical environment." It is Dr. Osborn's sixth honorary degree.

Who but a mother . . .

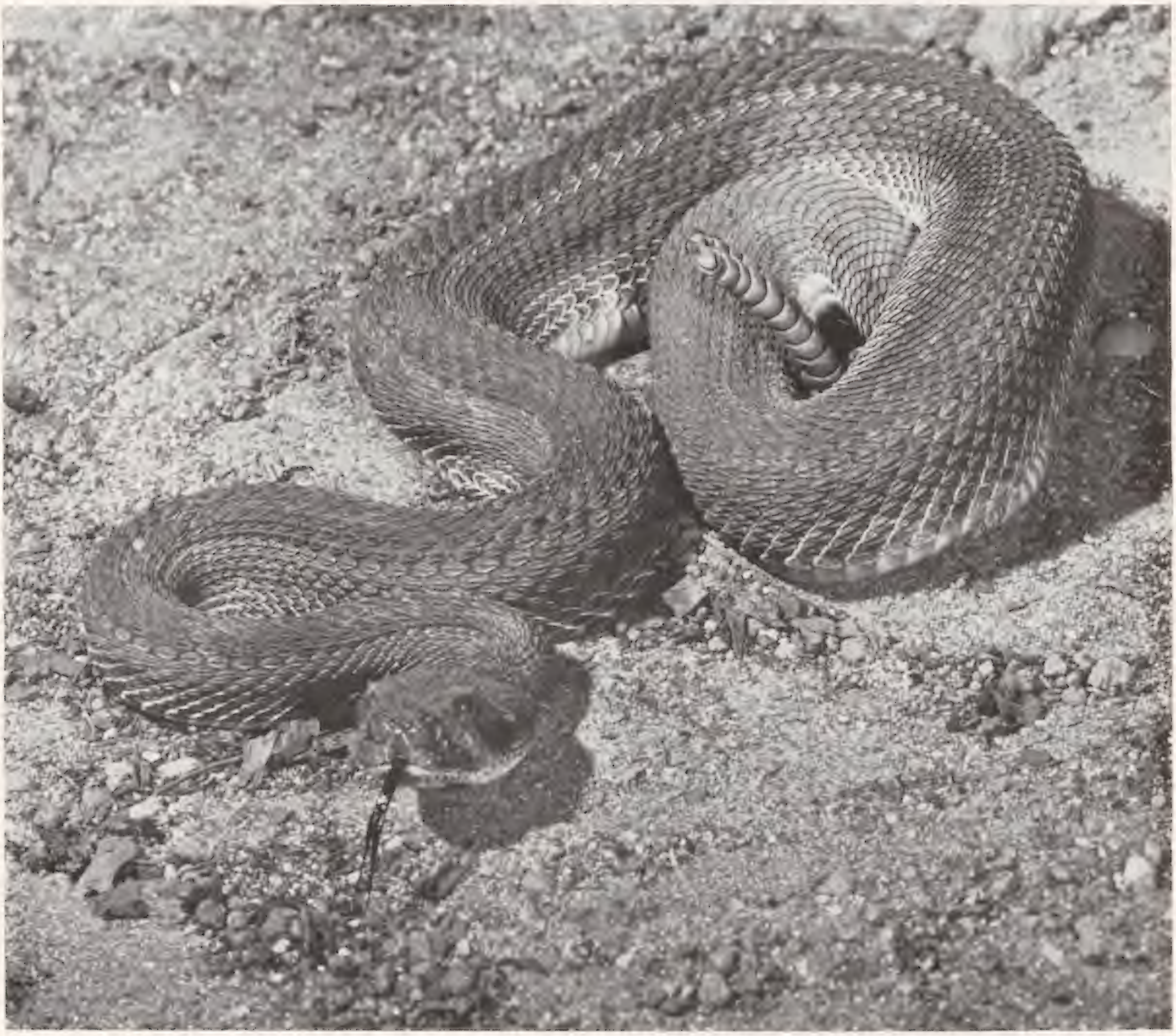
There have been more attractive babies, but few have prompted the interest that was engendered by the birth of Crandon Park Zoo's aardvark.

The new aardvark is the first known to have been born in captivity in the Western Hemisphere. A keeper at the Miami zoo found the wrinkled new arrival September 24, in the zoo's aardvark display. The mother, who showed no interest in the baby, is an Ethiopian aardvark received by the zoo in 1964.

Aardvarks (*Orycteropus afer*) are found in the wild only in Africa. Burrowing animals, they reach a weight of 100 pounds and may grow to six feet in length. When found, Crandon Park's baby aardvark weighed four pounds, two ounces.

Aardvark at Miami's Crandon Park Zoo weighed only four pounds, two ounces when found. Adult aardvarks reach a weight of 100 pounds.

Striped diamondback was sent to the Bronx Zoo from central Texas where two others were sighted several years ago.



THE bookshelf

SHARKS, SKATES AND RAYS. Perry W. Gilbert, Robert Mathewson, and David P. Rall, Editors. i-xv, 624 pp. The Johns Hopkins Press, Baltimore. 1967. $15.00.

What provokes shark attacks on humans and how to prevent them have been and still are the subjects of intensive research. As yet no one has come up with solutions to these complex problems. However, it has long been felt that before any meaningful answers can be obtained more knowledge on the basic biology of these great pelagic fishes and their relatives is needed.

Sharks, Skates and Rays is the proceedings of an interdisciplinary symposium sponsored by the American Institute of Biological Sciences, Office of Naval Research, and the American Museum of Natural History. The meetings were held at the Lerner Marine Laboratory, Bimini, Bahamas, on January 30 to February 5, 1966.

More than 50 scientists who have published extensively on the biology of elasmobranchs or who have used these fishes for experimental studies to resolve problems related to the biology of higher vertebrates, including man, have contributed 36 papers to form the basis of this excellent book. It brings together for the first time basic information on evolution, taxonomy, anatomy, physiology, and biochemistry of elasmobranchs and includes new information on social organization of shark populations, tagging sharks, and the shark-bite meter.

This book is more valuable to the scientist than the lay reader. Ross F. Nigrelli

THE LIVING WORLD OF THE SEA. By William J. Cromie. 343 pp. Prentice-Hall, Englewood Cliffs, N.J. 1966 (third printing 1967). $6.95.

In this book, William J. Cromie has successfully attained the two-pronged goal of every serious science journalist—his writing is crammed with scientific fact and makes lively, exciting reading for the layman. While it centers on life in the sea, Cromie's book also serves as a neat introduction to the biology and biochemistry of life for the casual reader.

Cromie builds a most basic setting for his survey of marine life. He begins at that forgotten time when the Earth was young and still a sizzling hunk of lifeless rock. Gradually, Cromie introduces the theories of the origin of life through discussion of present-day research. Where other writers of popular science might hesitate, Cromie plunges into the world of biochemistry, leading readers along the twisting helix of DNA, one of life's key chemicals.

Cromie traces the development of life from its primal stirrings to more complex organisms, and then, still early in the book, he turns to the sea in earnest.

He spans the sea from the abyssal plains to the whitecaps, describing sharks and sea snakes, clams and crabs. Cromie ends his book on a speculative note exploring the world of not-too-long-from-now when man will reap the resources of the world ocean.

Author of several books and magazine articles, Cromie speaks with authority when he writes of the sea. Now on the staff of an international science news and feature syndicate, he has been scientist, sailor, and journalist.

Edward R. Ricciuti

ABOUT THE authors

William M. Partington is conservation specialist for the Florida Audubon Society. He has been active in Florida conservation affairs. **Patricia O'Connor** is veterinarian at the Staten Island Zoo. **William J. Cromie,** based in Houston, is a noted author, science writer, and editor. He writes frequently on the sea. **Elysbeth H. Wyckoff** is production editor of ANIMAL KINGDOM.

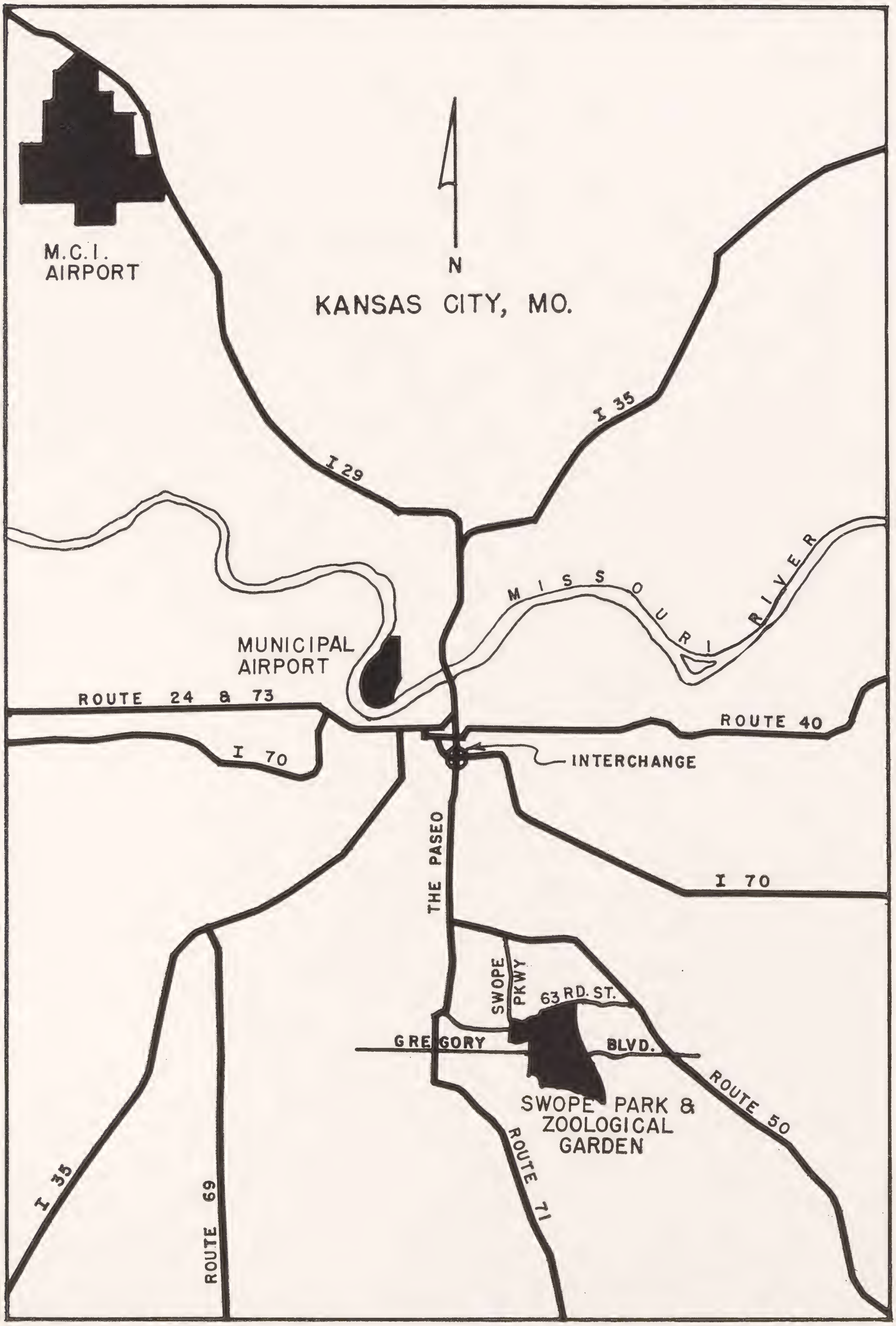
ILLUSTRATION CREDITS

Cover—N.Y.Z.S.; pp. 162-64—N.Y.Z.S.; pp. 167-68—William M. Partington; p. 169—Jim Brantly, Florida Game & Fresh Water Fish Commission; p. 170—William M. Partington; p. 171—N.Y.Z.S.; p. 173—South African Tourist Corp.; p. 174—Eideen Molloy; p. 175—San Diego Zoo; p. 176—Jeanne White, National Audubon Society; p. 177—The National Zoological Park; p. 178—San Diego Zoo; p. 179—South African Tourist Corp.; pp. 180-81, 183, 185—Miami Seaquarium; pp. 186-88—Elysbeth H. Wyckoff; p. 191 (top)—Miami-Metro News Bureau; p. 191 (bottom)—N.Y.Z.S.

Design by Edaik Rinden

VISITING KANSAS CITY?

The Swope Park Zoo, Kansas City, Missouri, features an African Veldt with Masai giraffes, elands, gnus, Damaraland zebras, and a pair of African elephants. Admission is free. So is parking.



This is one in a series of travel guides to zoos and aquariums presented by ANIMAL KINGDOM *as a service to its readers. We welcome submission of maps and information to be used on this page.*

NEW YORK ZOOLOGICAL SOCIETY

590.6T3
A59

SMITHSONIAN
FEB 15 1968
LIBRARIES

VOL. LXX, NO. 1, FEBRUARY, 1968

animal kingdom

CAT OF THE PHARAOHS

NEW YORK ZOOLOGICAL SOCIETY

630 Fifth Avenue, New York, N. Y. 10020

President
Fairfield Osborn

First Vice President;
Chairman, Executive Committee
Laurance S. Rockefeller

Vice-President
Henry Clay Frick, II
Robert G. Goelet

Treasurer
David Hunter McAlpin

Secretary
Howard Phipps, Jr.

Assistant Treasurer
Eben W. Pyne

Assistant Secretary
Harold C. Palmer

BOARD OF TRUSTEES

(*Executive Committee* *)
Alexander Aldrich, George F. Baker, Jr.*, Robert E. Blum, William R. Coe, C. Suydam Cutting, John Elliott, Charles W. Engelhard, Henry Clay Frick, II*, Robert I. Gannon, Peter R. Gimbel*, Robert G. Goelet*, Peter Grimm, John N. Irwin, II*, Warren Kinney, Anthony D. Marshall, Otto Marx, Jr., David Hunter McAlpin*, Peter Matthiessen, G. W. Merck, Charles W. Nichols, Jr.*, Fairfield Osborn*, Augustus G. Paine, II, Howard Phipps, Jr.*, John H. Phipps, John Pierrepont*, Eben W. Pyne, Laurance S. Rockefeller*, David T. Schiff, John M. Schiff, Henry Sears, Chauncey Stillman, Joseph A. Thomas, Landon K. Thorne, Jr., Alfred G. Vanderbilt, Robert Winthrop.

Ex-Officio:
The Mayor of the City of New York,
Hon. John V. Lindsay,
Administrator of Recreation and Cultural Affairs,
August Heckscher.

General Director
William G. Conway

ZOOLOGICAL PARK

William G. Conway, *Director & Curator of Birds;* Charles P. Gandal, *Veterinarian;* Hugh B. House, *Associate Curator & Chairman, Mammals;* Grace Davall, *Assistant Curator, Mammals & Birds;* David W. Nellis, *Mammalogist;* James G. Doherty, *Mammalogist;* Joseph Bell, *Associate Curator, Birds;* Donald F. Bruning, *Ornithologist;* F. Wayne King, *Associate Curator, Reptiles;* Herbert J. Knobloch, *Curator, Education;* Charles B. Driscoll, *Superintendent, Operations;* Edward Kearney, *Manager, Facilities Dept.;* Lee S. Crandall, *Zoological Park Consultant & General Curator Emeritus;* William Bridges, *Curator of Publications Emeritus;* Roland Lindemann, *Consultant, Mammal Management;* John M. Budinger, *Consultant, Pathology.*

AQUARIUM

Ross F. Nigrelli, *Director;* Nixon Griffis, *Administrative Assistant;* Robert A. Morris, *Associate Curator;* Lars Mellkvist, *Superintendent, Operations;* Jewell Bungay, *Business Manager;* Louis Mowbray, *Research Associate, Field Biology;* Christopher W. Coates, *Director Emeritus.*

OSBORN LABORATORIES OF MARINE SCIENCES

Ross F. Nigrelli, *Director;* Martin F. Stempien, Jr., *Assistant to the Director;* George D. Ruggieri, S.J., *Coordinator of Research;* William Antopol, C. M. Breder, Jr., Jack T. Cecil, Harry A. Charipper, Kenneth Gold, Myron Jacobs, Klaus Kallman, Vincent Liguori, John J. A. McLaughlin, Martin P. Schreibman, Eva K. Hawkins.

INSTITUTE FOR RESEARCH IN ANIMAL BEHAVIOR

(Operated jointly by the Society & Rockefeller University)
Donald R. Griffin, *Director;* Peter R. Marler, Jocelyn Crane, Roger S. Payne, Richard L. Penney, Fernando Nottebohm, George Schaller, Thomas T. Struhsaker, C. Alan Lill, O. Marcus Buchanon, *Resident Director, William Beebe Tropical Research Station.*

GENERAL

Walter Lerchenfeld, *Comptroller;* John McKew, *Personnel Manager & Assistant to the Director, Zoological Park;* Gordon Cuyler, *Membership Chairman & Administrative Associate;* Jerry M. Johnson, *Curator, Department of Exhibition and Graphic Arts;* Edward R. Ricciuti, *Editor & Associate Curator, Publications and Public Relations;* Elysbeth H. Wyckoff, *Production Editor;* Dorothy Reville, *Photo Librarian;* Sam Dunton, *Photographer.*

AFFILIATE

Jackson Hole Biological Research Station
L. Floyd Clarke, *Director.*

ANIMAL KINGDOM STAFF

Edward R. Ricciuti Editor and Associate Curator, Publications and Public Relations
Elysbeth H. Wyckoff Production Editor
Jerry M. Johnson Curator of Exhibition and Graphic Arts
Edaik Rinden Designer
Dorothy Revelle Photo Librarian
Sam Dunton Photographer
William Meng Photographer

animal kingdom

MAGAZINE OF THE NEW YORK ZOOLOGICAL SOCIETY VOL. LXXI NO. 1 FEBRUARY, 1968

ABOUT THE COVER

Inveterate cat fanciers, the ancient Egyptians went so far as to sculpt their adored Bastet, goddess of joy and love, in a feline likeness. The Egyptians even mummified their pet cats —remains by the thousands have been unearthed. Prominent among these remains are those of the African wild cat. On page 16, Dr. Reay H. N. Smithers writes of these cats, from pharaonic times to today.

CONTENTS

THE WRECK OF THE TORREY CANYON—EPILOGUE 4
by Alison Jolly

NEW GUINEA'S PINT-SIZE PARROT 14
by George Lippert

CAT OF THE PHARAOHS
The African Wild Cat from Past to Present 16
by Reay H. N. Smithers

STRANGEST LIMB ON MAN'S FAMILY TREE 24
by Stan Federman

JOHN TEE-VAN
A Memorial Article 30
by Fairfield Osborn

ANIMAL KINGDOM REPORTS 32

THE BOOKSHELF 34

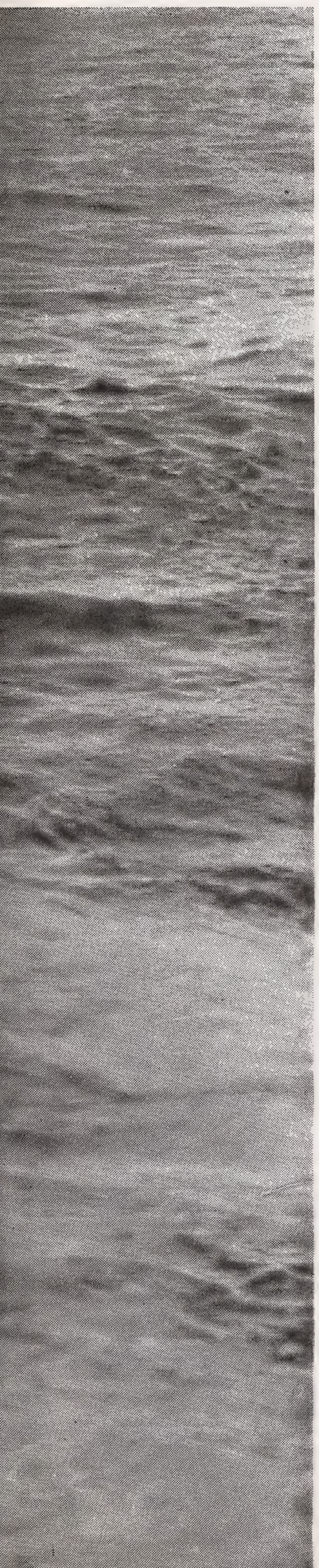
ABOUT THE AUTHORS 34

ILLUSTRATION CREDITS 34

Issued bi-monthly by the New York Zoological Society at the Zoological Park, Bronx, N. Y. 10460. Editorial and Subscription Offices at the same address. Title registered with the U. S. Patent Office. Subscription, $3.50 a year; single copy, 60 cents. Same rates for all foreign countries and Canada. Second-class postage paid at Bronx, N. Y. Send Form 3579 to Bronx, N. Y. 10460

© 1968 New York Zoological Society. All rights reserved.

Wreck of the Torrey Canyon —Epilogue



by ALISON JOLLY

CORNWALL LIVES BY NATURAL BEAUTY. Its people are gnarled and independent fishermen or farmers in close-walled fields—but every house offers bed and breakfast, and the towns are lined with lobster restaurants. Cornwall boasts Atlantic cliffs on the north side and subtropical palms in the sheltered southern valleys. People come as vacationers to seek their yearly dole of nature; or, if Cornish, they abide, accepting the lowest wages in England and letting rooms to the tourists rather than leave.

New Yorkers and Londoners may put up with scummy rivers and gas-fumed streets, but they dream that somewhere, in a Maine or a Cornwall, the air smells only of sea salt and flowers.

It doesn't.

The gigantic tanker *Torrey Canyon* guttered 60,000 tons of crude oil into the sea during March and April 1967. In defense of the beaches, the British government daily poured 90,000 gallons of strong industrial detergent on top of the oil. The black tide spattered over 100 miles of coasts, coming in glutinous slicks that fouled whatever they touched. (Cornwall suffered less than Brittany, over 55 miles of whose "pink granite coast" was continuously coated.) The stench of oil drifted inland, over the whole peninsula.

For wildlife, at least, the cure was almost certainly worse than the malady. Detergent does not seem to have saved animals from the oil slicks but simply to have added to the holocaust its own, far greater, killing power.

If it was really a choice between cleaning beaches for people and the conservation of sea life, then almost anyone would choose the people. This is true for commercial reasons,

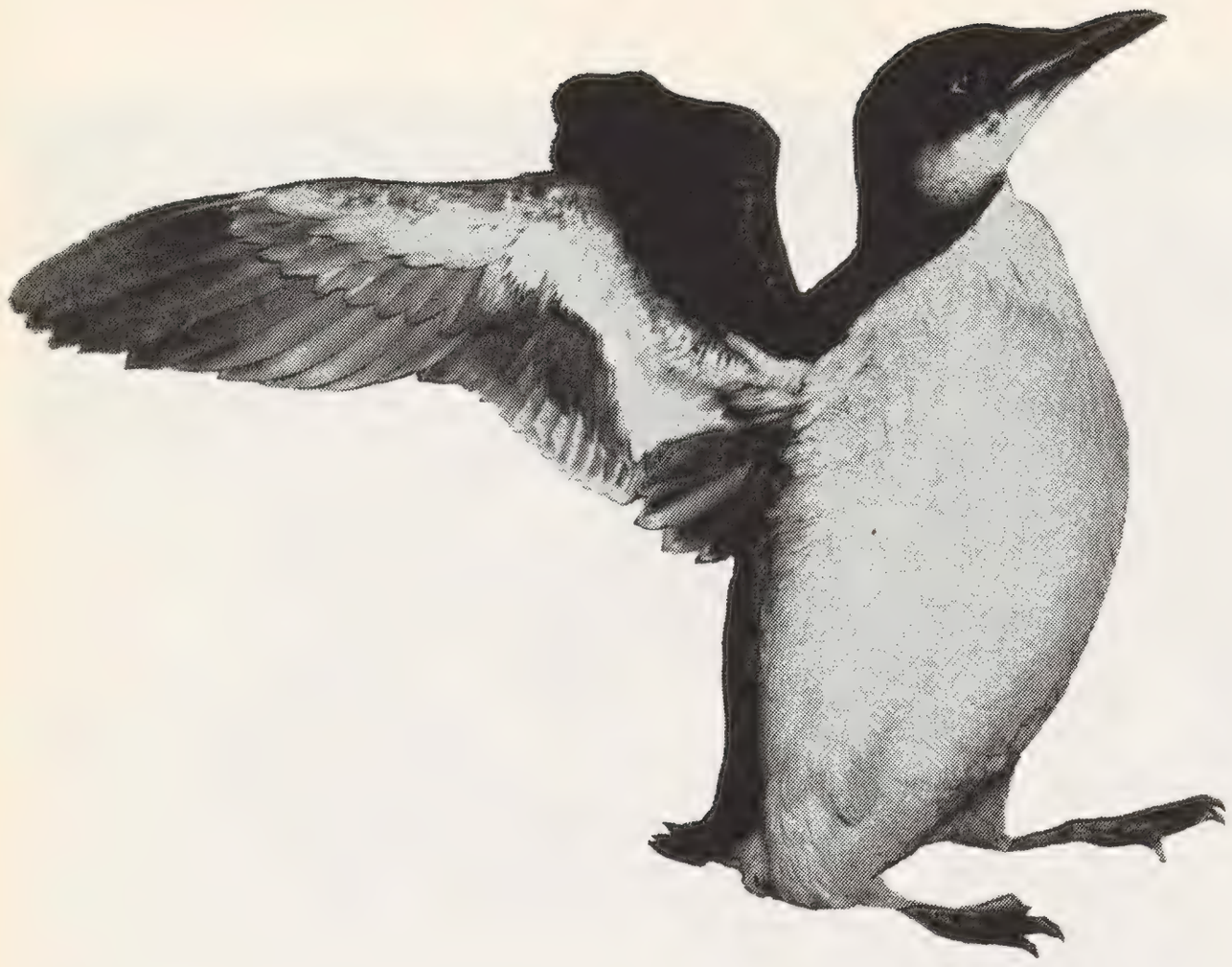
Air view of the harbor at Porthleven. Water is blackened with oil from the tanker "Torrey Canyon."

Soldiers and firemen in a small boat are surrounded by oil from the stricken tanker as they try to rig a floating "boom" to contain the slick before it moves into Porthleven Harbor.

since tourism brings in more income than fishing—Cornwall is a place for people to enjoy.

But what were the choices? What has the real effect of the detergent been? Scientists are only now adding up their counts of seabirds, lobsters, limpets, and bacteria. It will be years before the long-term effects unfold. In the meantime, few naturalists can believe that the British government has done the right thing.

It was the migrating seabirds who first brought publicity, for they suffered pitifully from the oil itself. In the month after the *Torrey Canyon* hit Seven Stones reef, 6,355 guillemots were washed ashore in Cornwall alone. Mrs. Olga Johansen of Mousehole and the other volunteers who helped her cleaned oil from nearly 3,000 seabirds, using vats of pink mascara remover on the black, slimy feathers. Mrs. Johansen showed me the 30 remaining guillemots at the RSPCA bird hospital, waddling about a cement cubicle with a washbasin-sized pool, waiting their turn to be sent to rehabilitation centers. "At the worst of it," said Mrs. Johansen, "there were 600 birds in this room. We tried to keep them moving,



In the month after the tanker hit Seven Stones reef, 6,355 guillemots were washed ashore in Cornwall alone.

not to smother each other, but finally I just left the dead ones where they were, blocking the corners to save the living."

Guillemots, or murres, are the northern equivalent of penguins, sleek black above, insulated white below. When happy, they taper to an upward pointing beak, wings akimbo like clowning penguins. When sad, and beginning the irreversible decline to death, they shuffle along on their heels, feathers bedraggled where the cleanser has washed them fluffy and the rain wet them through. They spend seven months of the year at sea, literally flying under water after their prey. The birds at Mousehole were going to their breeding grounds, where with "joy-flights and water-dances" (in the words of Leslie Tuck, the Canadian authority) they would have taken possession of sheer cliffs facing the sea. There, each female would have laid one egg on the bare rock and incubated it between her breast and her webbed feet. Eventually she would have leaped with her still flightless chick hundreds of feet into the sea, to swim and dive away for another season.

Instead, the birds met the oil.

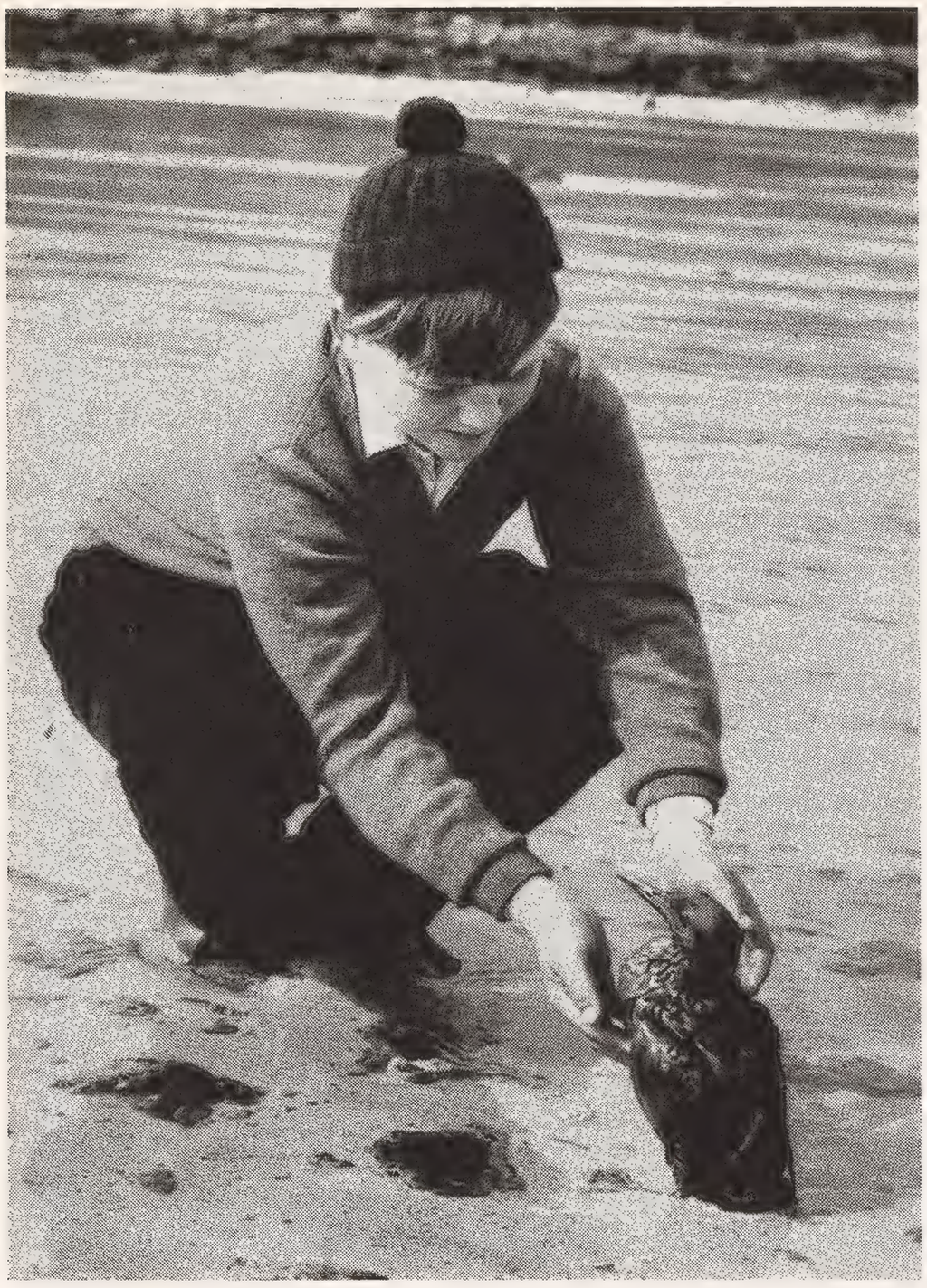
The Cornwall RSPCA centers handled 7,849 birds up to April 17. No one knows how many more birds sank at sea. The British Trust for Ornithology guesses the total kill to be 10,000 to 40,000 birds. Those that reached land without drowning died of shock, of cold as their insulation was destroyed, of starvation, and of oil impurities that produced stomach ulcers as a result of preening their feathers. The birds went on dying until, by April 17, only 450 of the RSPCA birds survived to be sent to rehabilitation centers. Unfortunately, those that lived through the first few weeks and seemed healthy could not return to the wild, for their natural waterproofing oils had been removed along with the crude oil from the Persian Gulf.

The seabirds' plight shocked many people. Peter Scott of the Severn Wildlife Trust appealed on television for the World Wildlife Fund, bringing in some £3,000 by the first mail from the British public. The New York Zoological Society has also contributed funds, which will be used for future research.

But was washing the birds really worth it, in view of the high mortality? The RSPCA has banded no birds in the past (here traditionally at odds with the ornithologists), so we do not know if any ever survive even a month after being released. By concentrating money, effort, and attention on this immediate problem, people have been distracted from the much greater question of detergent effects.

The detergent depot at Sennen Cove presented a beautiful mosaic: black drums with royal-blue ends, red with white ends, turquoise with yellow ends. Three orange bulldozers lounged beside, ready to funnel detergent into the sand at low tide for the rising sea to wash. The view was just right for a picturesque local-color painting of a fishing village, the westernmost village of England, with rain rivulets from the depot running white and frothy to the beach. The sand, at the end of May, seemed finally clean, but the rocks beside kept their chewing gum coat of tar.

Sennen Cove is notorious to biologists just now, for the first published study on effects of the *Torrey Canyon* was in part done here. Dr. A. J. O'Sullivan and Dr. Alison Richards shoveled out transects in the sandy beach and collected dying rock creatures. Their conclusion was that the oil was fairly bad—it coated the outside of seaweed and shells, clogging or suffocating some species. But the detergent was lethal. Everything with which it came into contact died.



A volunteer collects disabled bird in Cornwall. The Cornwall RSPCA handled 7,849 birds up to April 17. The British Trust for Ornithology guesses the total kill to be 10,000 to 40,000 birds.

A young bird spreads its wings in a vain attempt to fly, but the thick oil coating its feathers prevents flight.

This is really no surprise. Consider, for instance, the chemical structure of detergent and the construction of an oyster. Chemically, detergent is a double-ended molecule, one end attaching to water, the other to fatty substances. Sea creatures such as the oyster live in balance with their environment, separated from sea water by the thinnest of membranes, perhaps only two molecules thick. This leads to the uninitiate's picture of the oyster as a blob of glup and equally to the gourmet's view of it as etherialized ocean. And this also means that when detergent touches the protein-fat membrane, the oyster disintegrates—emulsified, just like the oil.

We do not know as yet the general picture of damage to sea life. The effects of such a major ecological change persist for years, so there is no possibility of knowing final results as yet. In the meantime one can only speculate from the acres of dead barnacles around the coast, the little red-legged crabs twitching as they die in clear water, the limpets lying on their backs. Limpets detached from their rocks, but whole and uneaten, are unnatural. Still, if the detergent effects are more widespread, the oil is no more pleasant—shellfish remain gummed to the tarry rocks, not so much putrefied as embalmed. Only quantitative data will clarify the question.

Another point, though, is whether so much detergent was the best answer for the beaches themselves. Much of the oil came ashore on the highest tides of the year. It settled in a filthy band, but some might have been removed and buried or might have coagulated with sawdust and leather shavings for easier handling.

In emulsion in the sea, waiting for the slow action of bacteria, the oil is very nearly immortal. With an onshore wind, the Cornish sea is pallid brown for hundreds of yards out, and wave spray sticks to the cliffs like mayonnaise. There is no guarantee that emulsion will sink forever, even on the bathing beaches —it may also seep out at low tide, to be washed up again.

Portheris Cove, a half-circle of rocky sand sheltered from the surf in the arms of rocky points, is the argument against detergent. Until the *Torrey Canyon*, this was an isolated spot, invisible from the road, to be reached only by walking down the clear stream, with its pre-

historic-seeming buttresses of an abandoned tin mine (even the industrial ruins in Cornwall are romantic). The forehead of the hill behind is slashed with a road, built for the tractors to tip over drums of detergent. Helicopters bombed the beach with detergent; the carcasses of smashed drums littered the rocks. This was done because they were afraid that oil would wash out of the lonely cove, to endanger tourist beaches.

And the result? The oil has washed out, in emulsified form. The rocks are fairly clean—but the sea is fouled. When the oil came, there was no sand in this cove, for it is yearly scoured clean by winter storms and relaid new every spring. Now the new sand stinks of oil, and as the tide recedes, each wave leaves its border of black ooze. The beach of Portheris Cove is unpleasantly beautiful, with the wave marks overlapping like black-edged scales of a great golden fish.

Roy Phillips showed me Portheris, in the course of the seabird breeding census. He is a naturalist who was working for the Nature Conservancy on a detailed survey—one of the many attempts to find out, afterward, just what the *Torrey Canyon* has done. Unfortunately in Cornwall there are no previous records tabulated, just the local knowledge of men like Phillips. In a way, though, the Cornwall breeding colonies are less important than others, being marginal for arctic birds like the guillemots and without the rarities that nest 15 miles away in the Isles of Scilly.

We walked over boulders with pungent flowers between: prickly yellow gorse, blue harebells, the light and dark pink of poverty and thrift. There was a badger set—holes smelling of mammal, fresh grass bedding at the entrance, feces that Phillips said meant young, as the adults would go farther from their home. A few steps more and Phillips sat down on a ledge over 200 feet above the surf.

Rosemergey Cliff, it's called, sliced by the sea into vertical shafts of granite, so we looked along at a series of sheer rock faces. From below, the granite columns stand up against the sky like cathedral pillars. Fishermen call the place the Three Brazen Men.

The cliff nearest us held the first of the seabirds. Highest, in the grass just by the lip of the rock, were two pairs of fulmars, gull-like birds that are actually shearwaters. Just watching the cant of their "nests" on the slippery verge made me cling even tighter to my own perch on the cliff edge. Next to them, a shag, a large cormorant species, gathered beakfuls of grass, pulling back with jerks of its snaky neck, then lurched off into space and soared in a tight circle to a bit of cliff I couldn't see. This is the inaccuracy of censusing—there is no way to observe every rock face, even from a boat. We did not dare approach too closely, for fear the birds would abandon their newly chosen nest sites altogether.

Several shags were in sight, on a stepped ledge, with whitewash spilling down from each level to the nest below. They like a ledge at least a foot wide, huge in seabird terms, if possible with several nests together. They also prefer to fish inshore, in the region now most heavily polluted. Next lower came the auks, the razorbills, and guillemots, but only a few—nine of one, seven of the other. At a distance each bird looked like a French curve of white against the granite: with white belly cut by the shape of the black wing. With binoculars one saw the bird, in the minute toehole they consider adequate for an egg. Phillips unleashed an ancient greening telescope, told me which were which, and said that none had yet laid. Two razorbills were mating, though, so it seemed hopeful.

Among and below the auks were the kittiwakes—gray gulls with wing tips, as Peterson's bird guide says, "dipped in ink." And below them, the sheer drop to the surging ocean, brown with oil emulsion.

There are more results, though still preliminary. Only half the usual number of shags came to the cliff we saw, most nesting in June, two months late. Gulls seem particularly badly hit; perhaps only 10 per cent of the normal population in the worst oil-and-detergent areas are breeding, and those few are late. The auks, the guillemots, and razorbills seem up to normal numbers, but they, too, are breeding very late. Thus, the birds we had feared for most,

the auks who dove through the oil yet swam ashore to be lovingly cleaned by the many Mrs. Johansens, may be no worse affected in the long run than gulls and shags, who left few corpses—but are laying few eggs. Phillips planned to have eggs analyzed to see if this late, partial breeding is traceable to detergents or if the birds may have been put off by prolonged disturbances from oil, helicopters, and squads spraying from the cliffs.

The seabird survey is typical of much biological work in that results unfold slowly. The number of dying birds washed ashore does not tell how many live to reach the cliffs. The number that land, preen, and court each other does not tell how many lay viable eggs. Even the breeding failure of one year does not tell which colonies will begin to recover the next and which may have slipped into a decline, eventually to abandon traditional sites. Nor, in fact, does the record of any one species show how they affect the ecology of others.

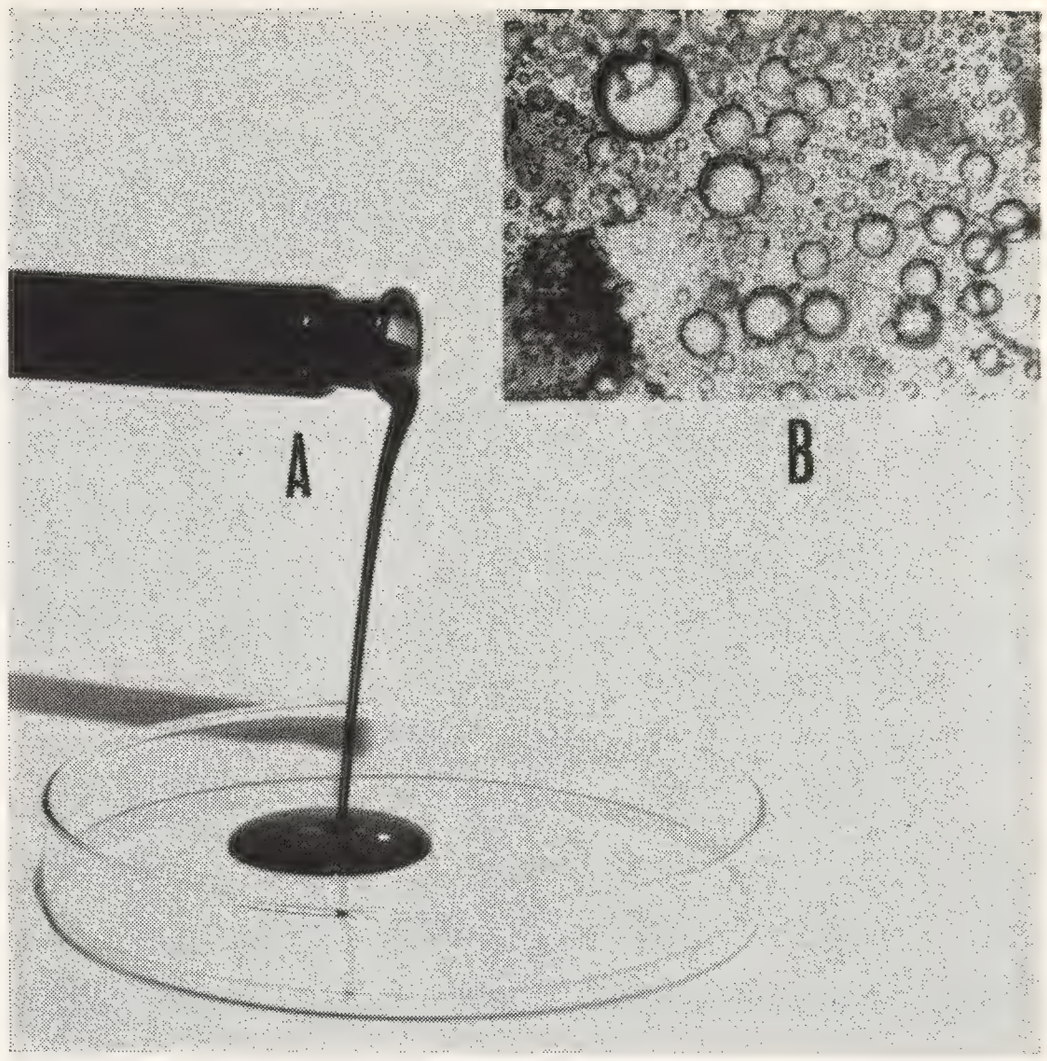
The *Torrey Canyon* disaster was, for most of us, without precedent. But oil pollution is not new. A year and a half ago, for instance, a tanker pumped 1,700 tons of diesel oil into the Medway estuary on an incoming tide, endangering bathing beaches and fouling 8,000 acres of salt marsh, an important bird breeding area. Two different accidents in the English Channel in 1966 left eight- and ten-mile slicks, and in the 1950s, an oil discharge killed 30,000 birds off Scandinavia, which compares with the toll of the *Torrey Canyon.* In fact, the long-term decline in British guillemots is generally attributed to oil pollution.

At the base of a 120-foot cliff, boys rescue oil-soaked seabirds from rocks at Hoe Point, a nesting ground saturated with oil. Birds were taken to a RSPCA shelter in Cornwall.

The accidents are as bad as the deliberate discharges. The Japanese tanker that spread an eight-mile slick off Land's End in 1966 was unusual only in being identified. (Mrs. Johansen washed 2,000 guillemots at Mousehole after that one.) Oil ships last spring were sluicing out their tanks in the Channel itself, knowing that the resulting mess would be blamed on the *Torrey Canyon.* Short of the sophisticated chemical analysis suggested by an editorial in *Science,* there is almost no way to trace offenders—oil slicks can drift, intact, hundreds of miles from their source.

"We should have been prepared!" said Miss Barclay-Smith, in her office in the British Museum. An ornithologist, secretary to the International Council for Bird Preservation, she is also secretary and moving spirit of the Advisory Committee on Oil Pollution of the Sea. This committee began in 1952 and spurred the International Marine Consultative Organization (IMCO) to adopt the present rules, the 1954 Convention for the Prevention of Pollution of the Sea by Oil. The convention, with its 1962 amendments, limits the areas where oil may be discharged and stipulates that devices to separate oil from sea water should be fitted on oil-carrying ships over 150 tons. These separators offer hope that the sea may be kept clear of oil. However, the convention applies only to ships of signatory countries and must be enforced through lawsuits under acts of individual countries. In theory, one could legislate an end to the oil that flecks the seashore from Cape Cod to the Cape of Good Hope, but governments have been so dilatory in signing even the current convention (the United States was one of the slowest, Japan not at all) that the amendments, voted in 1962, came into effect only last spring on May 18.

Miss Barclay-Smith is right. We should have been prepared. We should have known such details as how best to clean an oily guillemot. We should have known more about detergent effects in the sea, not just trusted the ocean to dilute it before too much harm is done. IMCO held an emergency meeting on May 4 and 5, when it considered far-reaching measures to restrict sea lanes of noxious cargoes,



A. Oil-like appearance of emulsion containing 30 percent water. B. Photomicrograph (160 x mag) reveals water droplets washed off tankers.

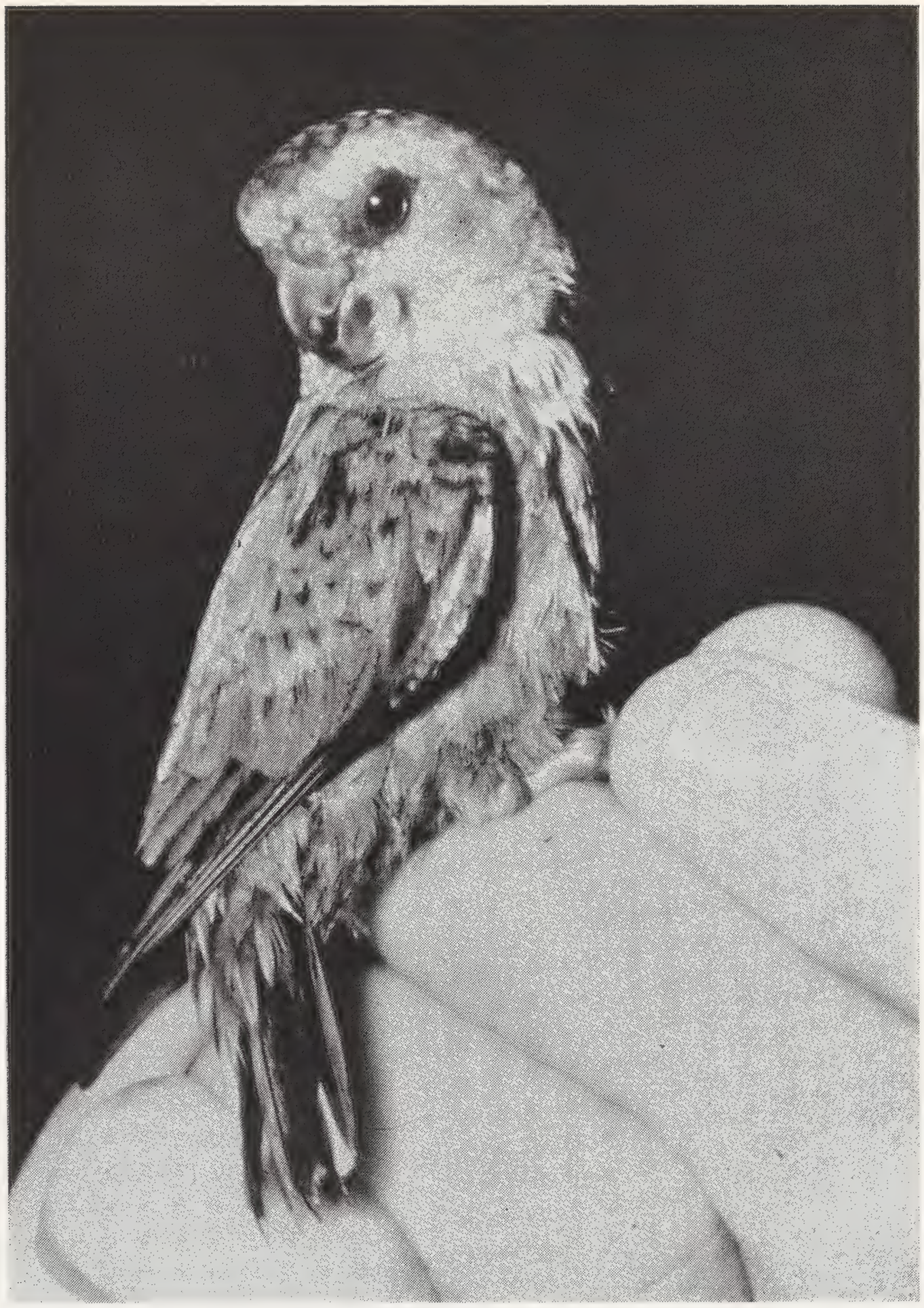
accident procedures, and research into means of controlling spilled oil without damage to fauna and flora—but we should have thought of all this before disaster, not afterward. Above all, the only effective approach is at the centers of power, through government pressure on the oil companies themselves.

Perhaps, at least, the *Torrey Canyon* has jolted us a little further toward reality. This is no small question—no matter of a few suffocating birds or a bather's tarry pants. I sat on the cliffs of Cornwall, a cliff where no seabirds came to nest last year, dazed by the surf cascading over a fissured lump of granite, large as a two-story house, far below. Farther up the coast, the sea had cut through granite in a more-than-Mycenean arch, the immense surges pouring through, first to one side, then back, hypnotic as Niagara. Out to sea, where the oil emulsion stopped and the Cornish blue ocean began, gannets drove steadily north and guillemots fished, bobbing under the waves.

This, after all, is where one would choose to be, on the cliffs in the sun above the blue ocean. And this is why pollution, by oil or anything else, is no question of details but of what man chooses to make of his life, his environment, his world.

ANIMAL KINGDOM sent the author to Cornwall last spring after the "Torrey Canyon" disaster.

Photo shows coast of Brittany two months after it was spoiled with oil from the tanker "Torrey Canyon." The French worked hard so that the beaches would be clean for the summer. The best method for cleaning the sand has been this German-made oil burner. The machine is loaded with dirty sand, which goes through a heating process and comes out clean. Over 55 miles of coast was continuously coated.



New Guinea's Pint-size Parrot

by

GEORGE LIPPERT

MOUNTAIN-CROWNED AND BEARDED with rain forest, New Guinea is one of the world's truly still-mysterious regions, particularly from a biological standpoint. You can stand on almost any hilltop in the interior of New Guinea and look out over mountain ridges that remain largely biologically unexplored.

This island, spread-eagled over the sea north of Australia's Cape York, harbors several fascinating but little-known species of animals, including the thick-furred cuscus and the dazzling birds of paradise. But perhaps no other New Guinea animals are more perplexing than the island's pygmy parrots—fluttering bits of color smaller than most sparrows.

One day while searching for insects along the edge of a dense lowland forest in southeast New Guinea, I was startled by what appeared to be a large greenish insect. I turned to my assistant, a local collector, and asked him to

go after the "insect." He insisted that it was a bird and suggested that we try to get it with a bird net. When we checked in the morning we had captured two tiny, blue-capped pigmy parrots, each only about 3½ inches long.

We took the little birds back to the house for closer examination and my partner, Peter Shannahan, a prominent New Guinea naturalist, photographed them. We identified them as *Micropsitta pusio*.

The tiny birds were perfect miniatures of larger parrots in every external detail except for the tail, where some of the feathers were stiffened with hard shafts. Pygmy parrots hop up trees in a manner similar to a woodpecker's. Like the woodpecker, the parrot's stiff feathers serve as a prop.

The small parrots nest in burrows which the birds dig in termite nests (or termitaria) on trees. These termite colonies are often several feet high and can extend around the tree.

Shannahan, who operates a zoo at Wau, New Guinea, tried on many occasions to maintain the pint-size parrots, but the birds died. Since the pygmy parrots had not touched the food given them, Shannahan surmised that the birds had died of starvation. He therefore examined the contents of the birds' stomachs and found a white pasty material. Assuming this was the digested remains of termites, Shannahan placed a colony of the insects in a cage with a group of new birds. The parrots, however, did not feed on the termites, nor on any of the dietary formulas Shannahan had used successfully on many other species of parrot.

What to feed pygmy parrots in captivity remains a problem. A Swedish naturalist, Sten Bergman, also tried to raise these birds. He observed another species (*Micropsitta keiensis*) eating a few termites, but was sure this was not the bulk of their food. He tried a mixture of bird seed, boiled potato, oatmeal, and shredded wheat with no luck. Then Bergman tried force-feeding the parrots with condensed milk, but this also failed. He managed to keep a half-grown chick alive for 66 hours, however, on a mixture of milk, wheat, flour, sugar, and mashed pawpaw. This could well be a record.

While it may appear that termites would be the pygmy parrot's most probable diet—since the birds nest in the midst of these insects—it is reasonably well established that, in the several species of birds that do nest in termitaria, the insects seal off the burrows which are exposed by the birds' activities. Thus the birds may not always have easy access to the termites.

Besides nesting in termitaria, at least one species, *Micropsitta bruijnii*, excavates a burrow in dead trees, according to L. A. Rand, reporting in the *Bulletin of the American Museum of Natural History*. Still, the stomachs of these birds contain the same white pasty material as that found by Shannahan in his *Micropsitta pusio*.

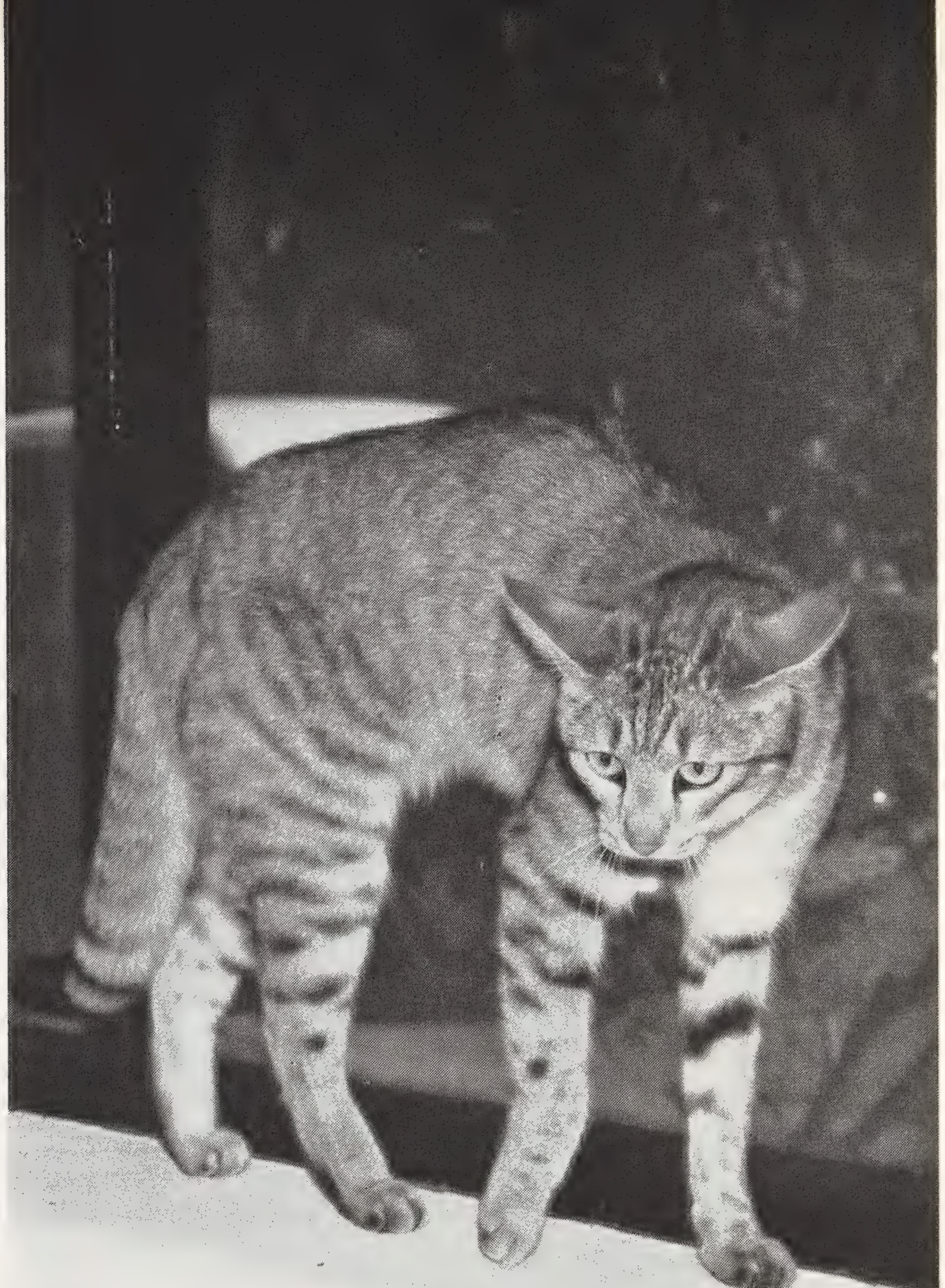
Noting that the birds he observed were most frequently seen climbing the trunks of rotten trees, Rand began to look on the decaying trees for a possible food. He found a fungus which often forms a jelly like layer on the rotted wood. By careful observation, he saw the parrots nibble on it. However, the question remains: is this fungus their main food?

If the diet of the pygmy parrot can be pinpointed, or a substitute developed, the birds could make excellent cage and zoo specimens.

Dr. W. C. Dilger, a specialist on parrots at Cornell University, believes that in time formulas will be developed. "After all," he points out, "it was only a few years ago that we could not keep hummingbirds for a similar reason, but the problem was overcome."

Ranging throughout New Guinea and the Solomon Islands, the five or six species of pygmy parrots—like many of the other species of birds and mammals which are limited to this area—are threatened by depletion of habitat through lumbering and burning.

It is unlikely that a developing country like New Guinea, practically devoid of roads and many other necessities, will be able to expend resources for research aimed at preservation of wildlife for some time to come. Researchers from other nations are welcome, however, and visiting scientists can acquire information applicable to future efforts at preserving New Guinea's wildlife.



Cat of the Pharaohs

THE AFRICAN WILD CAT FROM PAST TO PRESENT

by Reay H. N. Smithers

FROM THE VERY DAWN of recorded history cats have figured in the life of man. The sculptors of ancient Egypt over 4,000 years ago portrayed them in their limestone reliefs, obviously with regard and affection. Their Goddess of Joy and Love, Bastet, was frequently shown in the likeness of a cat, and pet cats were mummified, their remains often encased in beautiful bronze images and placed in the tombs of their owners. Small tombs were erected solely for cats, with saucers, presumably once filled with milk, being placed for the animals' use in the world of the hereafter.

In the latter part of the nineteenth century and early in the twentieth, the mummified remains of these cats were dug up in such huge numbers that they were used as fertilizer. The British Museum has a specimen taken from a consignment of 19 tons sent to England for this purpose. If each skeleton weighed eight ounces, this consignment alone represented some 80,000 cats.

Obviously, the Egyptians were appreciative of the value of cats in the destruction of snakes and rodents, for there are carvings on the ivory handles of knives illustrating cats killing snakes, and an exquisite painting in the tomb of Nakhte, Thebes, in 1415 B.C., of a cat killing a mouse under its owner's chair.

Now, where did these cats come from? We know that the Egyptians, long before the time of written records, had successfully domesticated cattle, sheep, donkeys, and pigs. Monkeys and apes, gazelles, ibex, and oryx were imported from countries to the south, but it was not necessary for them to import cats, as two species occurred naturally in Egypt. These were the swamp cat (*Felis chaus*), and the African wild cat (*Felis lybica*). Both species have been identified from mummified remains, the swamp cat short-tailed and much larger than the long-tailed African wild cat.

After examination of 190 mummified cats dating from 600–200 B.C., Morrison Scott of the British Museum recorded that, although the ancient Egyptians may have kept swamp cats, by far the largest proportion of this sample, 187 out of 190 were African wild cats (see photo on opposite page).

If you look at the paintings, the reliefs, and the bronze images of cats in the galleries of the Metropolitan Museum of Art in New York, there are several features of the majority of the cats which distinguish them from the conventional domestic varieties, with which we are familiar today. The legs and tail are long, the bodies elongated, the chest narrow, and the shoulder blades show prominently above the back, all of which are characters of the African wild cat.

You will notice that the majority of the Egyptian cats are depicted sitting in a more upright position than our domestic varieties. This is due to the great length of the front legs, which raises the chest and head high off the ground.

The gait of the wild cat has a great deal in common with that of its larger relatives, the lion, leopard, and, more especially, the cheetah. The movement of the high shoulder blades is probably the most obvious feature in common, and this, coupled with the long stride, gives a litheness lost in the shorter-legged domestic cat.

The general color of the wild cat varies geographically, and many races have been described. In the latitude of Rhodesia in the eastern higher rainfall areas, adults are dark gray, the markings black, while westward in the drier area of Bechuanaland and South West Africa they are much sandier and the markings reddish.

In the adults, the upperparts are plain with a darkening on the spine and very faint transverse bands, the latter more accentuated on the sides. The underparts are whitish to rich buff, plain or with indistinct spots. The limbs are distinctly marked with transverse bands both inside and outside, the tail with distinct bands and a broad dark tip.

The facial markings and narrow collar are black in the dark specimens and reddish in the sandy, and in all these the back of the ears is a bright rust color, a characteristic feature of the wild cat.

The markings, with the possible exception of the reddish ears, are very similar to the conventional "tabby" to be found in the back

In the latitude of Rhodesia adult wild cats are gray, with black markings. Westward in drier Bechuanaland and South West Africa they are sandier with reddish markings.

Komani, the author's pet wild cat, is marked with black. The back of the ears is a rust color. The limbs are distinctly marked with transverse bands both inside and outside.

Komani at four years shows the indistinct transverse black bands on the back. The distinctly banded tail has a broad dark tip similar to conventional "tabby."

alleys of any large city anywhere in Europe or the Americas, and surely what we are seeing in the "tabby" is simply a reversion to the general pattern to be seen in its primary ancestor, the wild cat.

F. lybica has a very wide distribution from near the southern tip of Africa throughout the continent into Arabia, parts of Asia and India, and the Mediterranean islands. Absent only in the most arid desert, in some areas it ranks as the most common small predator. It is one of the species of mammals which has benefited from man's activities in Africa, for, by the opening up of vast areas of the continent to agricultural development, man has created a better habitat for rodents, which form the principal food of the species. In the part of Africa with which the author is most familiar, including Botswana, Rhodesia, and Zambia, the wild cat is most frequently contacted at night in and around mealie (corn) lands where rodents are plentiful. The cats penetrate into the fringes of peri-urban areas, perhaps attracted by the heavier rodent populations found there.

In this part of Africa they appear to breed throughout the year, with a peak during the early months of the year. Up to five have been recorded at a birth, but three appear to be the more normal number. Litters have been found in standing crops where there is thick weed or other undergrowth. They will, however, litter down in any good cover of grass, underbush or rocky areas.

The wild cat breeds freely with domestic cats, and in the vicinity of large towns all sorts of crosses are found. Individuals which can be described as representing the true wild cat are rare in these areas. The differences between the wild cat and the crosses are fairly obvious as the crosses lose the red on the ears and are shorter in the legs.

One of the author's female wild cats, Komani, has now produced three litters of crosses, all with dark ears and short legs, the first litter being the best in color, closely resembling the mother. These have turned out to be splendid house cats, great hunters, and reached an adult weight of 12 to 14 pounds, some two pounds heavier than the mother. The

crosses are easy to handle and tame quickly. On the other hand, the progeny of Komani and a pure male from Botswana, Igola, were long-legged with red ears and from the earliest stages, unhandleable, spitting and scratching or diving for cover when approached. There are some complications in keeping three wild cats. One of these is that they are very territorially minded, and one eventually gains the ascendancy, driving the others away from the vicinity of the house.

Normally our three live in large enclosures in the garden. The two females, Goro and Komani, are let out in daily rotation in the early morning and return for their food just after sundown. In the earlier stages, we released them together, unfortunately at a time when we were leaving on holiday, with the result that Komani took to the bush for four months. When eventually recovered at night with the aid of a shooting lamp, it took her quite a few days to settle down, being nervous and shy. I will never forget that night, as I had previously spent weeks walking around the farm trying to call in a variety of cats, wild and domestic, that obviously did not respond to me. Somehow, I knew this night that it was Komani because, instead of moving off as the others had done, she very hesitantly moved toward me—near, but not near enough to catch. I called my wife, to whom she is particularly attached, and we sat down while she softly called the cat's name. It must have taken a quarter of an hour before Komani suddenly responded and came to her. The reunion was most moving, Komani going into transports of purring and rubbing herself against my wife's legs. It was to some extent humbling to find her in better condition than she had ever been under our immediate care.

Igola, the male, now has to be kept in, for chaos reigned when he was out. The bantams, chickens, and ducks went into paroxysms of fright as he tried to get at them through the wire of the run, the dogs slunk off, and the Siamese cats would take to the roof. Both Goro and Komani have caught bantams by getting them into a state of flurry and then catching them through the one-inch wire netting as they flew up toward the roof, a feat of some dexterity.

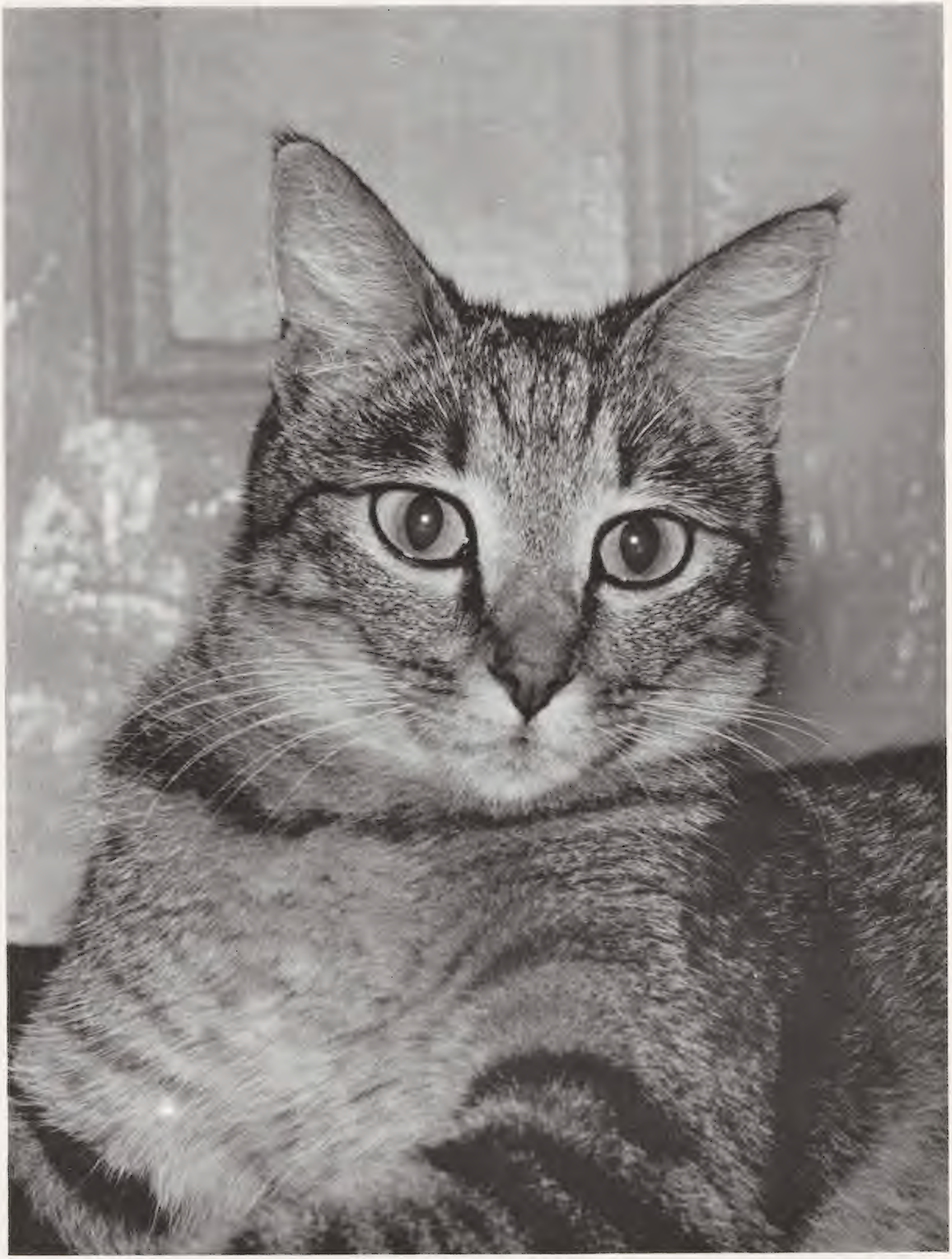
All three are inveterate and incurable thieves and at meal times have to be banished from the room. Even as kittens they showed their wild natures and, if smacked for jumping up on the table, instead of behaving like normal cats and flying through the door, they would lay their ears back, spit, show their teeth, and strike back. We discovered that a flick with a napkin or, better still, the use of an insect spray, which they particularly disliked, was a more effective and less painful way of getting rid of them. Another very effective method was to spit back as noisily as possible, a procedure only resorted to when my wife and I were alone.

As kittens they would stalk our peacock when he was displaying, leaping from behind onto his tail under cover of the spread feathers, sending him to the nearest tree, or onto the roof, squawking. The peahen was less easy to deal with, and quickly learned to turn on them and chase them off.

When they were about a year old, we were given a fine pair of geese which, we thought, because of their size and aggressive nature, were pretty safe. This appeared to be confirmed as, on the first encounter with our two dogs, the geese chased them with flapping wings and outstretched necks into the shelter of the house. Not so with Goro, who, at first contact, had one by the neck, and would have killed it had we not come to the rescue. The geese, like the peacocks, were given to safer homes. We no longer keep poultry.

Goro has strongly developed "auntie" instincts, and when Komani has kittens will frequently bring along a mouse and deposit it outside her enclosure. Komani will not, however, tolerate the presence of Goro or any other cat near her kittens, and adopts a particularly aggressive attitude in such situations. She does not object to the approach of the dogs, and in fact both she and Goro get on very well with them and will rub themselves against the dog's legs and curl up in front of the fire with them.

These cats never do anything by halves; for instance when returning after their day out they are inclined to become super-affectionate. When this happens, one might as well give up what one is doing, for they will walk all over



Goro has strongly developed "auntie" instincts, and when Komani has kittens will frequently bring along a mouse and deposit it outside her enclosure. Komani, however, will not tolerate the presence of Goro or any other cat near her kittens. Goro also gets on very well with the dogs and will rub against their legs and curl up in front of the fire with them.

The hunting instinct in Igola, the male, is extremely strong and chaos reigned when he was out. The bantams, chickens, and ducks went into paroxysms of fright as he tried to get at them through the wire of the run. Both Goro and Komani have caught bantams by getting them into a state of excitement and catching them through the one-inch wire netting as they flew up toward the roof, a feat of some dexterity. In the wild, these cats feed predominantly on rodents, but also eat a wide variety of other animals, including birds, reptiles, insects, scorpions, solpugids, spiders, termites, and centipedes. The largest known mammal taken by a wild cat was a springhaas, which in its adult form may weigh up to nine pounds. The largest bird was a red-crested bustard, about the size of a chicken.

the paper you are writing on, rubbing themselves against your face or hands; or they will jump up on your shoulder and insinuate themselves between your face and the book you are reading, roll on it, purring and stretching themselves, sometimes falling off in their enthusiasm and, in general, demanding your undivided attention.

They are very clean and completely "housetrained," and in their enclosure use a sand box. They go to tremendous efforts to teach their kittens to use this and, in their early stages, a great deal of demonstrative digging and sorting goes on.

In the wild, they feed predominantly on rodents, but also eat a wide variety of other animals, including birds, reptiles, insects, scorpions, solpugids, spiders, termites, and centipedes.

The largest known mammal taken by a wildcat was a springhaas (*Pedetes capensis*), which, in its adult form, may weigh up to nine pounds. The largest bird was a red-crested bustard (*Lophotis ruficrista*), about the size of a chicken.

In spite of the fact that, in parts of Botswana, rodent populations are at unprecedented low levels, due to disease and three years of drought, and trapping records show extraordinarily low catches, wild cats taken in these same areas show full meals of rodents, thereby putting the zoologist and his fancy traps to shame.

Strangest Limb on Man's Family Tree

by STAN FEDERMAN

WHEN THE LAST great dinosaur lay down to die about 70 million years ago, another, more versatile, class of animals already waited in the wings, ready to inherit dominance over the earth from the reptiles. These were, of course, the mammals, which had developed during the reign of the huge saurians.

Among these early mammals were small, rat-sized creatures, which had furtively hidden in the dark corners of the tree tops, away from the giant reptiles. As the dinosaurs faded into history, these little mammals descended from the trees and began to move about more freely on the ground.

But one group of animals declined to give up the still comparative safety of their tree homes. They continued to live high off the ground, existing mainly on a diet of insects.

Originally, they were probably similar to the tiny tree shrews of today. But eventually they developed into the great order of the primates —which includes monkeys, apes, and man.

Among the primates is the prosimian group —a vital evolutionary link now regarded by zoologists as the most primitive of all the primates. Prosimians are so archaic in character as to give one the sense that they have only recently emerged from the mists of the prehistoric past.

The largest living group of prosimians is composed of the lemurs that live on the remote island of Madagascar. Now the Malagasy Republic, this island has often been labeled evolution's liveliest museum.

Other sizable groups of prosimians are fairly rare and are confined to a few species in Africa and the Malayan archipelago. They include the bug-eyed loris of Ceylon and Malaya; the tiny tarsier of the Philippines; and the galago, potto, and angwantibo of Africa.

The name "lemurs," derived from the Latin "lemures," which means "ghosts of the dead," was probably inspired by the animals' large, wide, staring eyes.

Left unmolested in an area generally free of natural enemies, the lemurs have survived and prospered in their island stronghold and have evolved unusual physical forms and intriguing behavior patterns.

Some have shrunk to the proportions of a mouse, others have grown as large as a sheep dog. Some are nocturnal in their habits, others are quite active by day. Some are carnivorous, others are strict vegetarians. Most lemurs still live in trees, but a few roam on the ground. Some are slow and sluggish, but most move with incredible speed.

Above all, the lemurs and their country cousins from Africa and the southwest Pacific islands are solitary, evasive, and very secretive in their ways. All prosimians have a basically gentle temperament and are quite charming. Many species of prosimians can be seen today at the Oregon Regional Primate Research Center, located on a lush, green 250-acre campus 12 miles west of Portland, where they are an integral part of a colony of more than 1,000 primates. Ranging from tarsiers to the huge howler monkeys of South America, the priceless Oregon collection is considered one of the finest in the world. It includes more than 225 prosimians—the most ever to be housed under one research roof in the entire Western Hemisphere.

All primates share certain anatomical, physiological, and behavioral characteristics that place them close to man. Primates are man's nearest kin, and a knowledge of their biological attributes is an investment in the future of man —and yields a better understanding of evolution itself.

Dr. William Montagna, center director and chairman of its Division of Cutaneous Biology, explains that the center's research activities are concerned with the entire life span of the animal as it relates to health and disease.

"By studying a primate from birth to death, we hope to learn how we can better man's own health," he says.

Interested in prosimians almost all his life, Dr. Montagna brought 80 of them to the center upon his appointment as director four years ago. He had used them while a professor of biology at Brown University, where he had begun comparative studies of their skins and processes related to skin such as sweating.

From these 80, the center has slowly and patiently built up its prosimian colony, which today is considered to be just about the most extensive and rare anywhere in this hemisphere.

Although the center's 50 or so scientists have been deeply engrossed in varied studies on other primates—especially the stump-tailed macaque and rhesus monkey—research on prosimians has been mainly confined to social and behavior observations while the prosimian colony was expanding.

"We have been mainly concerned with reproduction of our prosimians here in captivity," says Dr. Montagna. "Studies in prosimian reproduction, metabolism, embryology, and behavior patterns have yielded gratifying information so far—but we have much more extensive plans for them in all phases of evolutionary research."

He notes that the center is seeking to obtain all existing forms of prosimians so as to establish it as a world-wide information place for this primate group.

The Oregon Regional Primate Research Center was established in 1960 by grants to the Medical Research Foundation of Oregon from the National Institutes of Health. The University of Oregon is the host institution, with the dean of the medical school acting as administrator of the center and the foundation acting as its governing body.

First of seven in America, the center was established as part of a comprehensive program by the National Institutes of Health of the Public Health Service. The primary purpose of the center is to make primates available for research and to provide physical facilities and instrumentation.

The setting for the center is one of woodlands and meadows with a year-around stream, an atmosphere conducive to study. It is also an area free from air pollutants that might be injurious to those animals that live in the outside runs and corral. There are three large buildings on the campus and five smaller utility structures.

Favorites of almost all the scientists and handlers at the center are the prosimians. Because of their retiring ways, they are most difficult to capture in their natural habitat—and they are fascinating to all by virtue of their very "rareness."

Once in captivity, the creatures present constant problems for the center. The tiny tarsiers, for example, normally eat lizards, grasshoppers, and other large insects, especially crickets. Lizards are almost impossible to supply because of their expense—and crickets have to be imported from Louisiana. Therefore, the center handlers slowly wean the tarsiers away from their natural diet to a menu of fruits, greens, and ground-up chicken necks.

"It got so that they liked the chicken necks so much they were turning their noses up at the crickets," said Dr. Montagna.

To watch a prosimian is to be transported back to the prehistoric world. Most have highly movable digits—but although all secure their holds by grasping, their actual modes of progress vary. The African galago is extremely fast, agile, and accurate. By contrast, the lorises of Asia and pottos of Africa are unbelievably slow. Their method of progress is beautifully suggested by the native word for the potto—the "softly-softly."

The potto's foot has a single claw, the "grooming claw," which it uses to clean and comb its hair. The claw is located on the second toe, but all the other digits have the flat nails common to primates.

Like cats, lemurs constantly groom themselves; the ring-tailed lemur even has a specialized gland on the inside of its forearm, above the wrist, which produces a secretion, with which the lemur "wrist marks" its tail. The huge tails of most lemurs are almost twice as long as their bodies. At night, during Oregon's rainy season, a lemur often wraps its tail about itself, like a blanket, to keep warm.

The center recently obtained some mouse lemurs, which are little known and rarely seen, even in nature. Standing only about four inches tall, they are nocturnal insect-and-fruit-eaters, solitary, and, despite their size, extremely belligerent. Like the slow lorises, they dislike being disturbed during the day, and handlers always wear heavy gloves.

Asiatic lorises, like the potto, are slow and deliberate in movement. They are strictly arboreal and are most active at night. They have an almost owlish appearance at times and have an owlish way of swaying back and forth while looking at you.

Tarsiers have mobile heads, which they can swivel 180 degrees right or left. Their enormous eyes are the largest in the prosimian order for their size—tarsiers are rat-sized—and they also have proportionately the longest legs and largest ears. They move by jumping.

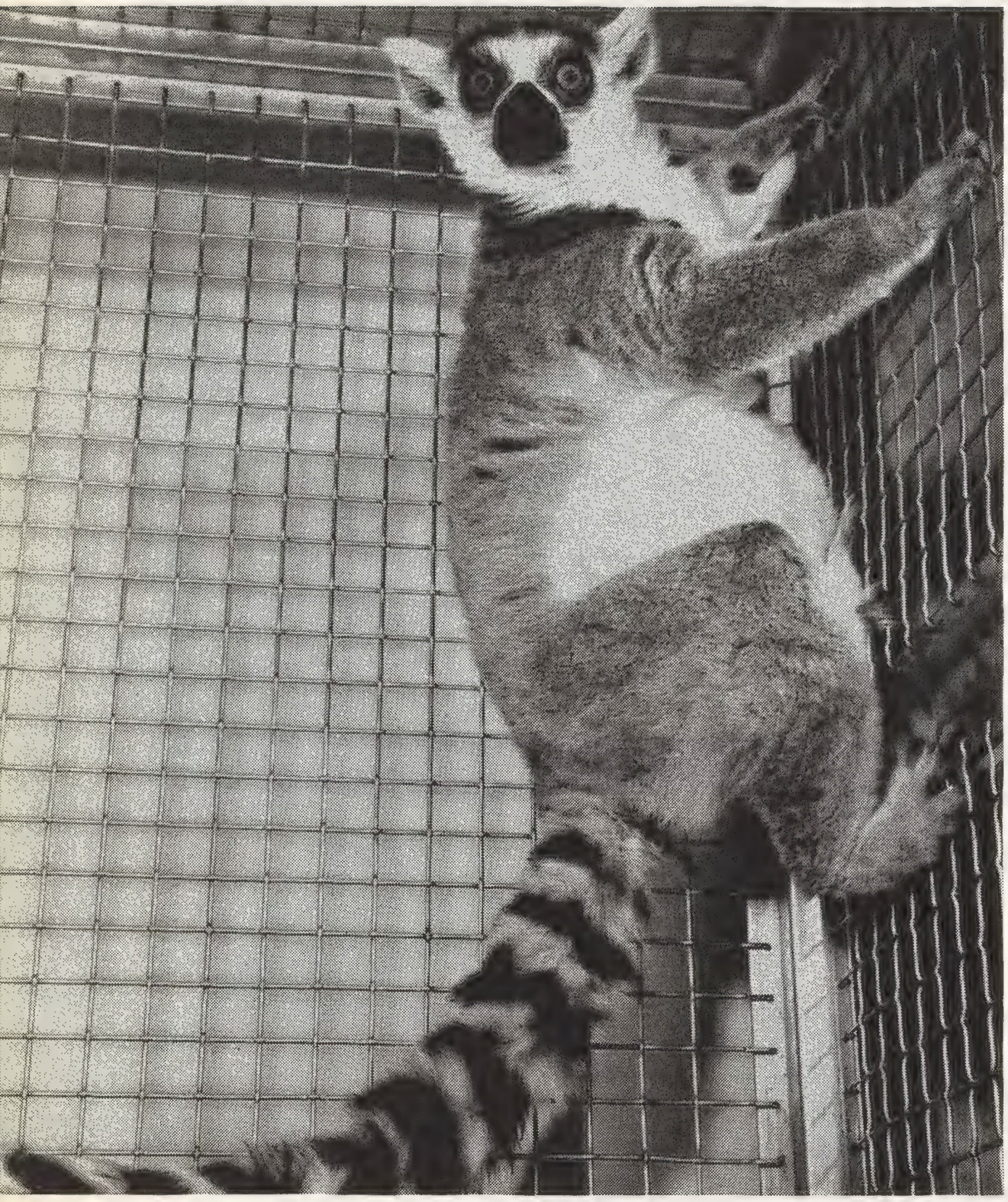
Galagos have huge ears, much like those of a bat, which can be folded back like an accordion at the whim of their owner. This furling and unfurling of their ears is carried out frequently and produces a quizzical expression on their faces. Quite tame and gentle, they have a remarkably acute sense of hearing. Their oversized ears can detect sounds up to a mile away.

Most of the center's prosimians are charac-

Tarsiers are very small with rat-like tails. They become quite hysterical and excited when annoyed.

The grand galago lives in the Congo area of Africa.

Dr. William Montagna, center director, holds a grand galago. Its oversized ears resemble those of a bat; its grasping hands seem almost human.



This male ring-tailed lemur looks like someone caught in the act of raiding the refrigerator. It is as big as a cat and weighs about eight pounds. Ring-tailed lemurs, commonly seen in zoos, are the clowns of this group and are always on "stage" for handlers and visitors at the Oregon Regional Primate Research Center.

terized by their wide, large eyes, kitten-soft fur, and manlike hands that produce strong grips. They also have a "sound" all their own.

The ring-tailed lemur often cries like a baby when excited; the potto has a growl similar to a dog. The fulvous lemur grunts like a pig, and the slow loris, when angry, emits a sound much like that of a rattlesnake. All male lemurs sometimes throw back their heads and howl like a coyote when they are lonely.

And, according to Eddie Duro, the center's prosimian handler supervisor, the animals "let us know—loudly—when it's mealtime."

The center is very proud of the prosimian reproductive records. More than half of the group of 225 have been born at the center—and the gallagos, the best breeders, are already into the fourth generation.

Dr. Montagna lists several reasons for the center's reproductive successes but notes that the need for careful dietary and nutritional elements are a prime prerequisite for prosimian breeding.

"These are such delicate, unusual animals," he says, "that you must have them in the best of health if you hope to breed them. If we allow them to get too fat, they lose interest and will rarely breed. So we then have to cut down their food intake. What it comes down to is knowing how much to feed besides knowing what to feed."

The center's prosimians all receive some kind of prepared food pellets reinforced with vitamins. They all like fruit—and this is a staple of their diet. They also receive meat such as beef and chicken in ground form.

Besides the prosimians' dietary needs, the center also pays a great deal of attention to their environment, and all rooms are kept at moderate temperatures. The animals are also given a chance for daily exercise; the more active ones are placed in extralarge cages.

Prosimians often have many phobias, especially of loud noises, which always frighten them. As a result, one of the quietest places in all of the metropolitan Portland area is the center's prosimian building.

All this pampering has produced excellent results. Not a single prosimian species at the center has failed to breed.

After a baby is born, the mother is immediately isolated from the male, and a semidark, extraquiet atmosphere surrounds her cage so that she can get used to her young. The cage is usually large enough that there is little chance of the mother accidentally injuring the young.

Most prosimians produce from one to four young. The best breeders are, of course, the gallagos, which come into estrus most frequently. Among the lemurs, the ring-tailed and fulvous have reproduced very well at the center. The pottos and lorises have been less commonly bred at the center.

Most of the prosimians normally produce one or two young at a time. The youngsters usually spend their first weeks riding upside down by grasping the mother's stomach hairs. Once weaned from their mother's milk, the

growing youngsters become quite active and gregarious.

The center, despite its initial successes in breeding its prosimian colony, is not standing on its laurels.

"We can't get complacent here," says Dr. Montagna. "These animals are the type that need constant care if we are to carry out our hopes for them. Until now, we have mainly been concerned with matters of animal husbandry and breeding. Now we hope to put them to sound research uses."

For, like the rest of the center's primate colony, the prosimians are all part of the center's reason for being—that of some day obtaining answers to the mysterious questions involving man's evolutionary heritage.

From the flat face and close-set eyes of some common ancestor of all primates, man derived his stereoscopic vision. This enabled him to see the world in three dimensions, to gauge distances, and to move swiftly and surely through his environment. He also inherited his wonderfully nimble hands. And, in the end, given such sight and hands, he evolved a brain capable of utilizing these physical assets.

Now, at the Oregon Regional Primate Research Center, researchers are attempting to find links with man's past and to peer into his future. The strange and shy prosimians, themselves a still living link to man, will play a key part in this effort.

Baby fulvous lemur travels upside down, hanging onto its mother's stomach. Fulvous lemurs become quite tame in captivity.

John Tee-Van

A MEMORIAL ARTICLE

by Fairfield Osborn

EDITOR'S NOTE—*John Tee-Van, director emeritus of the New York Zoological Park and the New York Aquarium, died at his home in Sherman, Connecticut, on November 5 at the age of 70. He was beloved by all, as attested in the following tribute by the president of the New York Zoological Society.*

WHEN JOHN TEE-VAN died, someone remarked that "his going represents the end of an era." Although this comment is not an original one, it is in this case particularly appropriate. John Tee-Van's career and the practices of his life stemmed from an earlier period, many of whose customs and influences now no longer exist and, as far as one can see, are gone forever. No longer, as a general rule, does any youth today start his life's work at the age of 14, as John did, nor enter into work with a similar feeling of independence and self-reliance.

John started as an apprentice keeper in the New York Zoological Park and concluded his life's work as general director of the zoo and the aquarium. At the age of 20 he left the zoo to become first field assistant to William Beebe, at that time curator of birds and later founder and director of the New York Zoological Society's Department of Tropical Research. The ensuing 25 years were marked by his participation in a stream of expeditions to many different countries and environments, from jungle areas to marine depths. He resourcefully responded to the varied tasks that his brilliant and highly energetic leader assigned to him. As always, he applied his full concentration to carrying out his work, which he did with high success.

In 1940 he returned to the zoo, having been appointed executive secretary and administrative assistant to the president of the society, which led in 1952, as mentioned above, to his becoming director of the Zoological Park and eventually general director of both the zoo and the aquarium.

His steadfast and able work led to his ever-growing reputation for unusual competence and resulted in his receiving a number of honors of various kinds—an Honorary Degree of Doctor of Science by Rensselaer Polytechnic Institute; his appointment to the editorship of an extensive series of volumes, *Fishes of the North Atlantic;* and election to the presidency, successively, of the New York Academy of Sciences and the Explorers Club.

He had unerring convictions as to what was right or wrong. His complete integrity combined with his constant thoughtfulness toward others were perhaps his most outstanding personal characteristics and remain etched sharply in the memories of all who knew him—so sharply that time will not erase them.

animal kingdom
NEWS OF ZOOS, AQUARIUMS, AND CONSERVATION
REPORTS

Release to the Wild

The first release to the wild of an endangered bird species from the Patuxent (Maryland) National Wildlife Center may come this year.

The bird is the masked bobwhite quail (*Colinus virginianus ridgwayi*), native to southern Arizona and Mexico. Announcement of the impending release was made by South Dakota Senator Karl E. Mundt, long-time congressional supporter of the Patuxent installation.

Propagation efforts at Patuxent to increase the quail population have met with a great degree of success, according to Senator Mundt. More than 150 young quail may eventually be available for release in the bird's original United States range.

The Patuxent center's endangered wildlife species facility at Laurel, Maryland, has been working on production of masked bobwhites since April, 1966, when it was the recipient of a gift of four pairs of masked bobwhites donated at the senator's request by Seymour and James Levy of Tucson, Arizona.

Senator Mundt, sponsor of funding amendments in the Senate Appropriations Committee to establish the endangered species laboratory facilities at Patuxent, said that the Levy brothers for several years have conducted their own efforts to propagate masked bobwhites and were able to make the additional birds available to the newly established propagation facility.

No estimate can be made of the number of masked bobwhites still existing.

Most of the young quail at Patuxent are beginning to assume adult plumage, with the black masks of the males the most conspicuous field mark to meet the eye.

The masked bobwhite formerly ranged through middle Sonora in Mexico to about 50 miles north of the United States—Mexico border in southern Arizona and from the Baboquivari Mountains east to the upper Santa Cruz Valley.

Its habitat in Arizona, where it was found until the early 1900s was tall grass-mesquite plains.

AAZPA Elections

Clayton F. Freiheit, curator of the Buffalo Zoological Gardens, has assumed the presidency of the American Association of Zoological Parks and Aquariums, a national organization for zoo and aquarium professionals.

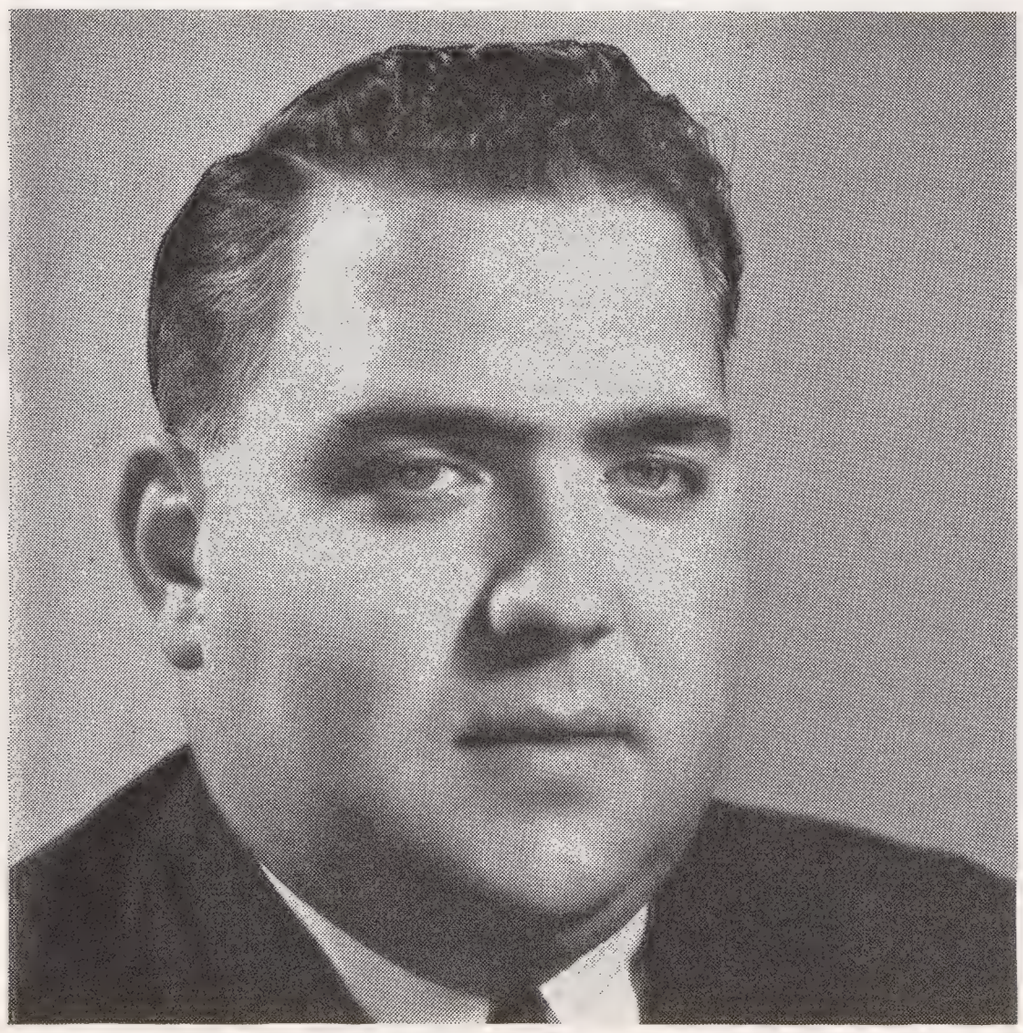
Mr. Freiheit was elected to the position in December by the association's executive board. He will serve for a year.

In his new AAZPA post, Mr. Freiheit succeeds William G. Conway, general director of the New York Zoological Society.

Mr. Freiheit has been a member of the AAZPA since 1957, when he joined the association as a student at the University of Buffalo. He became a fellow of the group in 1960. He has served on several AAZPA committees and in 1962 was elected to the Board of Directors for a three-year term. In 1965, Mr. Freiheit was named vice-president of the AAZPA.

A ZOO FIRST

This youngster is the first oil bird to be successfully kept in the zoological park for more than a month. The bird was captured in the Oropouche Cave of northern Trinidad by a team from the Bronx Zoo. Brought to the zoo in June 1967, the bird was reared at the home of Joseph Bell, associate curator of birds, until November. Although this bird is not yet on exhibit, it is hoped that the species will be exhibited in the zoo's new World of Darkness building, scheduled for opening this year.



THE bookshelf

FOUR-LEGGED AUSTRALIANS. By Bernhard Grzimek. Hill and Wang, New York, 1967. Translated from the German by J. M. Brownjohn. 300 pp., with 107 drawings and photographs, of which Alan Root took 62 for the author. $7.95.

"Oh, well," hummed the farmer as he gave a gentle stroke to his gun. Absentmindedly he kicked the belly of the dying kangaroo, then strolled away, off to count sheep. This is not a quotation, but as a sketch it would seem true to the mood Grzimek sees in that continent's settlers.

Books about the Australian and Tasmanian fauna are bound to be a bit depressing. Species after species has been trapped and poisoned, clobbered and shot into extinction. Man after the dingo; man after the kangaroos, the emus, the wallabies, the birds of paradise. Indeed, a merry-go-round it is, Australia.

Perhaps this is an unnecessarily harsh view. There are positive sides to the carnage, fortunes to consider. Indeed, a country which was unkempt, unproductive, uncivilized, has made considerable progress. A land where "useless" beasts romped and roamed alongside with "useless" natives, is now in danger of losing many of its unique animals.

About these and other matters writes Grzimek. This is not the first time that the author speaks eloquently against man's needless slaughter of less expansive species. His previous books (*Serengeti Shall Not Die* and *Rhinos Belong to Everybody*, among others) have been as forceful, as inspired, and as timely.

Not all of *Four-legged Australians* is a biography of murder. There are many accounts of surviving species, some of which are even making a fair comeback: the koala and the wombat, the platypus and the echidna. Among those that have been pushed too far is the Tasmanian wolf, now confined to a mountainous and forested terrain, a marginal habitat for this species: "They will not survive now even if no one ever harms them again. The only real way of saving them would be to set aside some open land and stock it with game, but it does not look as if anyone will go to such expense for the sake of a 'predatory pest.'" It is strange that no one in the world should take up this challenge.

This book includes much of interest on the life habits and natural history of many of the native marsupials and birds. It presents also a knowledgeable section on the rabbit problem that has now affected that country for several decades, and information on the impact that introduced animal species have had on the ecology of the land. Another interesting section is titled "How the camel conquered Australia." It gives a thrilling review of the explorers' quest to open up the interior of that continent.

This is a well-written book, a book packed with valuable information. It presents the view of a highly-educated man on the vanishing and unique fauna of a continent. It reads well and its main points strike home in a forceful manner.

Fernando Nottebohm

ABOUT THE authors

Alison Jolly is a biologist and author. **George Lippert** is a naturalist who has studied his parrots in the field. **Reay H. N. Smithers** is Director of Museums in Rhodesia. **Stan Federman,** a journalist, frequently writes on science and nature.

ILLUSTRATION CREDITS

Cover—The Metropolitan Museum of Art, purchase, 1958, funds from various donors; pp. 4-9, 11—UPI; p. 12—Standard Oil Company; p. 13—UPI; p. 14—Peter Shannahan; pp. 16, 18-19, 21-23—Mrs. H. J. Smithers; pp. 24, 27-29—David Falconer; p. 30—NYZS; p. 32—Glen Smart; p. 33 (left) AAZPA: p. 33 (right) NYZS.

VISITING OKLAHOMA CITY?

More than 1,200 specimens are exhibited within the 110 acres of the Oklahoma City Zoo. The zoo is open year-round and features a fine collection of hoofed animals and a children's zoo.

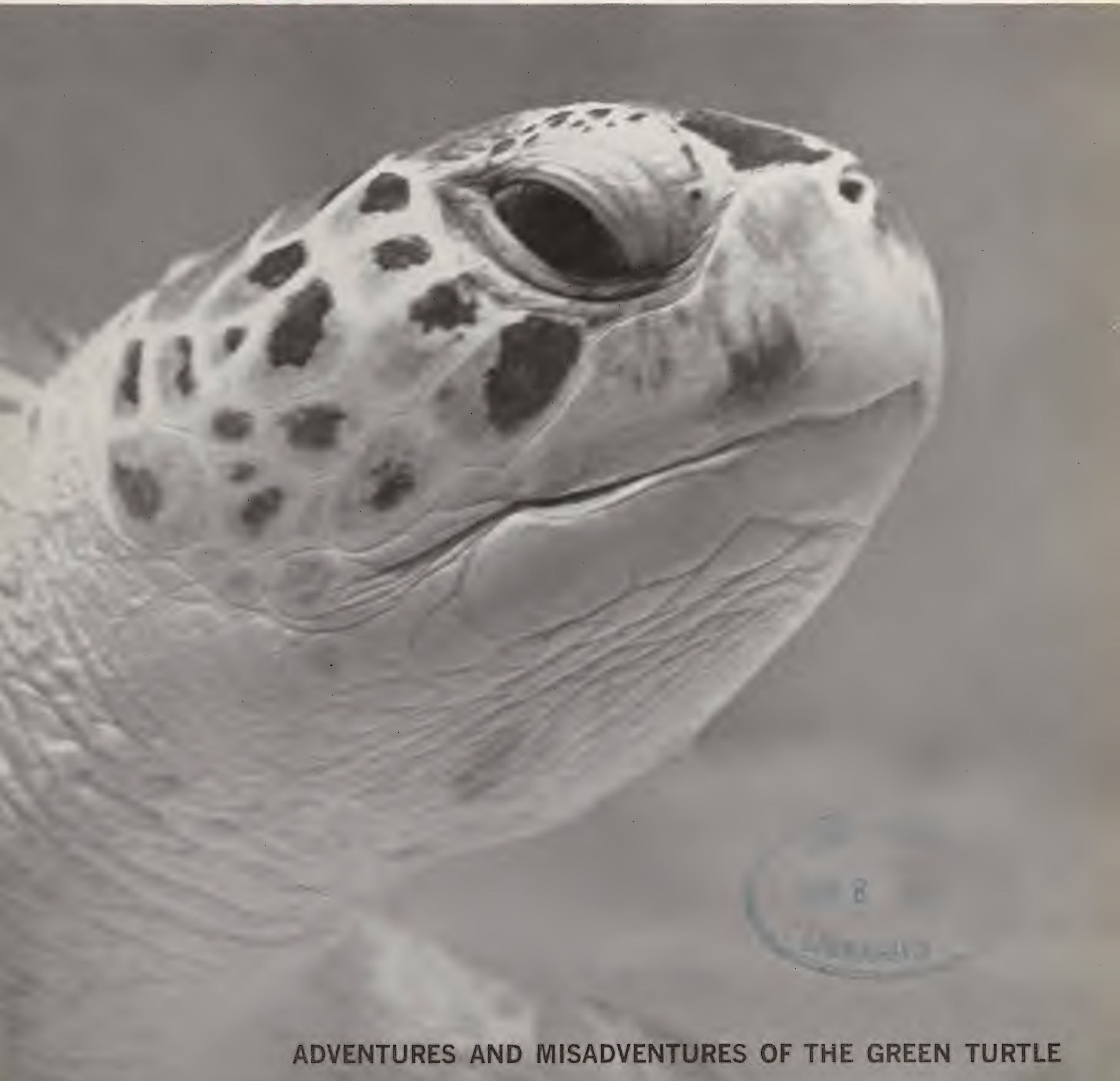
This is one in a series of travel guides to zoos and aquariums presented by ANIMAL KINGDOM *as a service to its readers. We welcome submission of maps and information to be used on this page.*

NEW YORK ZOOLOGICAL SOCIETY

590.673
A59

animal kingdom

VOL. LXX, NO. 2, APRIL, 1968



ADVENTURES AND MISADVENTURES OF THE GREEN TURTLE

NEW YORK ZOOLOGICAL SOCIETY

630 Fifth Avenue, New York, N. Y. 10020

President
Fairfield Osborn

First Vice President
Laurance S. Rockefeller

Vice-President
Henry Clay Frick, II
Robert G. Goelet

Treasurer
David Hunter McAlpin

Secretary
Howard Phipps, Jr.

Assistant Treasurer
Eben W. Pyne

Assistant Secretary
Harold C. Palmer

BOARD OF TRUSTEES

(*Executive Committee* *)
Alexander Aldrich, George F. Baker, Jr.*, Robert E. Blum, William R. Coe, C. Suydam Cutting, John Elliott, Charles W. Engelhard, Henry Clay Frick, II*, Robert I. Gannon, Peter R. Gimbel*, Robert G. Goelet*, Peter Grimm, John N. Irwin, II*, Warren Kinney, Anthony D. Marshall, Otto Marx, Jr., David Hunter McAlpin*, Peter Matthiessen, G. W. Merck, Charles W. Nichols, Jr.*, Fairfield Osborn*, Augustus G. Paine, II, Howard Phipps, Jr.*, John H. Phipps, John Pierrepont*, Eben W. Pyne, Laurance S. Rockefeller*, David T. Schiff, John M. Schiff, Henry Sears, Chauncey Stillman, Joseph A. Thomas, Landon K. Thorne, Jr., Alfred G. Vanderbilt, Robert Winthrop.

Ex-Officio:
The Mayor of the City of New York
Hon. John V. Lindsay,
Administrator of Recreation and Cultural Affairs,
August Heckscher.

General Director
William G. Conway

ZOOLOGICAL PARK

William G. Conway, *Director & Curator of Birds;* Charles P. Gandal, *Veterinarian;* Hugh B. House, *Associate Curator & Chairman, Mammals;* Grace Davall, *Assistant Curator, Mammals & Birds;* David W. Nellis, *Mammalogist;* James G. Doherty, *Mammalogist;* Joseph Bell, *Associate Curator, Birds;* Donald F. Bruning, *Ornithologist;* F. Wayne King, *Associate Curator, Reptiles;* Herbert J. Knobloch, *Curator, Education;* Charles B. Driscoll, *Superintendent, Operations;* Edward Kearney, *Manager, Facilities Dept.;* Joseph A. Davis, Jr., *Scientific Assistant;* Lee S. Crandall, *Zoological Park Consultant & General Curator Emeritus;* William Bridges, *Curator of Publications Emeritus;* Roland Lindemann, *Consultant, Mammal Management;* John M. Budinger, *Consultant, Pathology.*

AQUARIUM

Ross F. Nigrelli, *Director;* Nixon Griffis, *Administrative Assistant;* Robert A. Morris, *Associate Curator;* Lars Mellkvist, *Superintendent, Operations;* Jewell Bungay, *Business Manager;* Louis Mowbray, *Research Associate, Field Biology;* Christopher W. Coates, *Director Emeritus.*

OSBORN LABORATORIES OF MARINE SCIENCES

Ross F. Nigrelli, *Director;* Martin F. Stempien, Jr., *Assistant to the Director;* George D. Ruggieri, S.J., *Coordinator of Research;* William Antopol, C. M. Breder, Jr., Jack T. Cecil, Harry A. Charipper, Kenneth Gold, Myron Jacobs, Klaus Kallman, Vincent Liguori, John J. A. McLaughlin, Martin P. Schreibman, Eva K. Hawkins; Eva A. Suba.

INSTITUTE FOR RESEARCH IN ANIMAL BEHAVIOR

(Operated jointly by the Society & Rockefeller University)
Donald R. Griffin, *Director;* Peter R. Marler, Jocelyn Crane, Roger S. Payne, Richard L. Penney, Fernando Nottebohm, George Schaller, Thomas T. Struhsaker, C. Alan Lill.

WILLIAM BEEBE TROPICAL RESEARCH STATION

O. Marcus Buchanan, *Resident Director*

GENERAL

Walter Lerchenfeld, *Comptroller;* John McKew, *Personnel Manager & Assistant to the Director, Zoological Park;* Gordon Cuyler, *Membership Chairman & Administrative Associate;* Jerry M. Johnson, *Curator, Department of Exhibition and Graphic Arts;* Edward R. Ricciuti, *Editor & Associate Curator, Publications and Public Relations;* Elysbeth H. Wyckoff, *Production Editor;* Dorothy Reville, *Photo Librarian;* Sam Dunton, *Photographer;* Bernard M. Fagan, *Accounting Manager.*

AFFILIATE

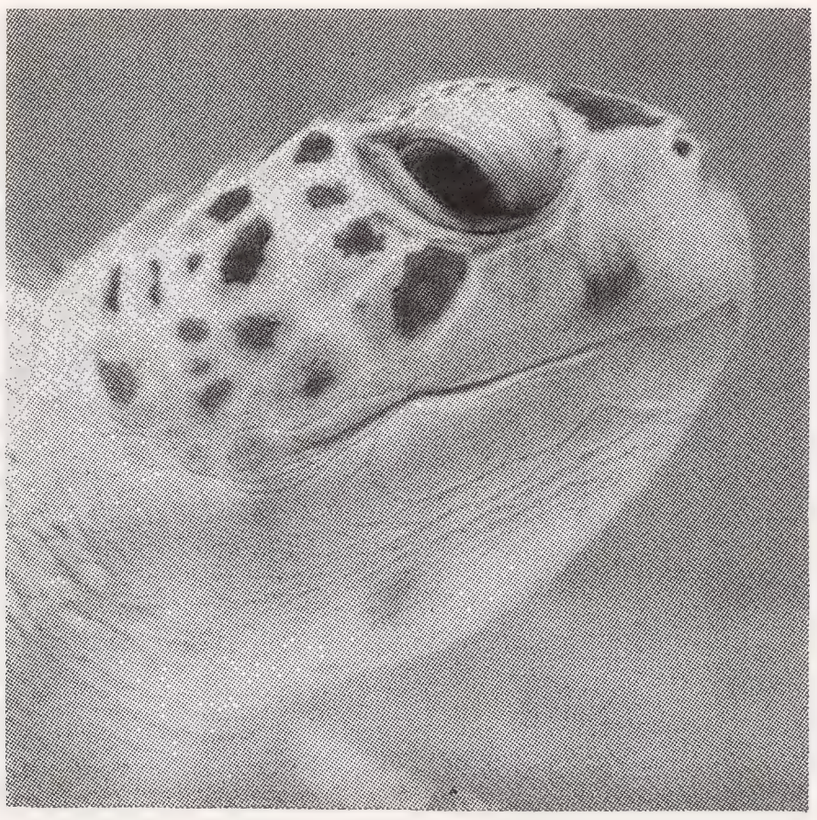
Jackson Hole Biological Research Station
L. Floyd Clarke, *Director.*

ANIMAL KINGDOM STAFF

Edward R. Ricciuti Editor and Associate Curator, Publications and Public Relations
Elysbeth H. Wyckoff Production Editor
Jerry M. Johnson Curator of Exhibition and Graphic Arts
Edaik Rinden Designer
Dorothy Reville Photo Librarian
Sam Dunton Photographer
William Meng Photographer

animal kingdom

MAGAZINE OF THE NEW YORK ZOOLOGICAL SOCIETY VOL. LXXI NO. 2 APRIL, 1968



ABOUT THE COVER

If any turtle can be said to be accompanied by an aura of romance, it's the far-voyaging green turtle. The repeated return to surf-washed nesting beaches, the potential economic importance of this sea reptile, and the mystery of the way the turtle navigates trackless expanses of ocean make a fascinating story. The green turtle and scientific efforts to study and preserve it are described in a two-part series by author William Cromie.

CONTENTS

ADVENTURES AND MISADVENTURES OF THE GREEN TURTLE
Part I—Misadventures 4
by William J. Cromie

DUCK DISPLAYS 12
by Jack and Inger Bradbury

BARRABEA—A MAMMAL THAT HATCHES 20
by John Hillaby

AN ORDERED SOCIETY Life In a Macaque Troupe 22
by Stan Federman

FLORIDA'S DIAMONDBACK HOLDS ITS GROUND 28
by William M. Partington

ANIMAL KINGDOM REPORTS 30

THE BOOKSHELF 33

ABOUT THE AUTHORS 34

ILLUSTRATION CREDITS 34

Issued bi-monthly by the New York Zoological Society at the Zoological Park, Bronx, N. Y. 10460. Editorial and Subscription Offices at the same address. Title registered with the U. S. Patent Office. Subscription, $3.50 a year; single copy, 60 cents. Same rates for all foreign countries and Canada. Second-class postage paid at Bronx, N. Y. Send Form 3579 to Bronx, N. Y. 10460

© 1968 New York Zoological Society. All rights reserved.

Adventures and Misadventures

The GREEN TURTLE

PART I—MISADVENTURES

By William J. Cromie

After laying her eggs Chelonia scatters sand over the nest with her flippers, concealing the eggs from predators.

TORTUGUERO, COSTA RICA—I looked down the silvery path formed by full moonlight on the Caribbean surf and saw a large, smooth rock glistening with reflected light. At least I thought it was a rock until it began to move—ponderous, intermittent movements as if something heavy was dragging its bulk out of the sea, a slow step at a time. I stood absolutely still and watched the gleaming form hunch out of the foaming surf. It looked like some gigantic armor plated insect, newly crawled forth from the basement of the world. I could not have been more impressed if I'd seen a dinosaur emerging from the sea.

Indeed, sea turtles similar to that before me existed in the time of the last dinosaurs. Aslosh with hormones and laden with eggs, the reptile was in the act of performing a nesting ritual millions of years old. Dinosaurs and, later, primitive men likely had watched this ritual and violated it to feed on turtle meat and eggs. Now I approached the big reptile, armed not with claw or club but with a notebook and metal tags.

The great armored hen lumbered up the beach and pushed into a line of low, bushy coco plums well above high tide. She began swiping at the black sand, first lethargically, then with an excited sense of purpose. She thrashed out a body pit to rest in while laying. When satisfied with its depth, the turtle began to dig an urnlike nest in the bottom of the pit with her rear flippers.

I sat down on a log to watch by moonlight as she alternately used one flipper then the other to scoop out sand and push it away from the lip of her nest. After about a half-hour, the digging stopped and the turtle's body began to heave and strain. Tears rolled out of her eyes, washing away the caked sand and ridding her system of excess salt. She sighed heavily, making sounds like a blowing whale. It was plain that *Chelonia mydas*—the green turtle—feels birth pangs.

I shined my flashlight under her tail and watched white, golf ball-sized eggs drop into the hole. *Chelonia* finished laying and covered her nest. She scattered sand around with her flippers to conceal the precise location of the eggs from feral dogs, jaguars, and other predators.

As she started back for the sea, I blocked her way and grabbed one scaly flipper at the "shoulder" and "wrist." As the big reptile lifted her body for the next advance, I jerked the flipper upward with all my strength then quickly pressed my knee against her belly shell. The turtle came up on her side and we seesawed in that position, neither gaining on the other. Then I could hold her up no longer. She plopped back on her belly and headed for the sea as fast as her ponderous hulk would permit.

I ran in front of her and again grabbed a flipper. The turtle kept moving ahead and I held on loosely. Anxious and distraught now, she moved faster and lifted her body higher than usual. When her belly came up clear of the beach, I yanked the flipper up and threw my weight against her shell. Locked hand in flipper we tottered back and forth again, but after a few seconds I felt her begin to yield.

I put all my strength into a final push, then jumped back. The turtle toppled over in a flurry of flying sand and flaying flippers.

The great reptile vented her frustration by pounding violently on her armored chest with long winglike flippers. When her slaps lost their willful energy, I jammed an icepick through the leathery skin at the rear of her flipper. She did not resist this too strenuously, and the tab of the metal tag seated in the hole on the first attempt. I secured the tag in place with pincers, then flipped the turtle right side up. She shuffled quickly into the sea.

I caught two or three glimpses of her moonlit shell in the surf, then *Chelonia* disappeared from sight. She would not be back to Tortuguero for another two or three years. Perhaps before that time the turtle would fall prey to fishermen working the seaweed pastures where she feeds. If they spot the tag, the turtlemen will see that there is a reward for returning it to Professor Archie Carr at the University of Florida. When this happens, we discover where the green turtle goes to feed between nesting trips to Tortuguero, but the route she and others follow and how they find their way remains unknown.

Green turtles average between 200 and 300 pounds, although a rare Brobdingnagian may reach 850 pounds. Some 4,200 of them have been marked at Tortuguero since 1954. Of these about 175 were recovered outside Costa Rican waters—some from as far away as 1,500 miles. Turtlemen working off Nicaragua sent in most of these tags. A few others were picked up off Cuba, the Yucatan peninsula, the Cayman Islands, Panama, and the Gulf of Maracaibo, Venezuela.

Every summer, green turtles leave feeding grounds in these locations and swim to Turtle Bogue, as the Creole fisherman call Tortuguero. Males either travel with the females or make precisely timed rendezvous off the black sand beach. When they begin to arrive in late June, courting, mating, and fighting start immediately.

These violent encounters may serve to fertilize eggs to be laid during the following nesting season—two or three years hence. The females, often scratched and lacerated from the male's attentions, lumber ashore. They stop in the backwash to look this way and that and to press their snouts against the sand. A turtle may get on with her nesting or turn

A turtle is tagged on Tortuguero. Some 4,200 of the animals have been marked in this way since 1954. Turtlemen are rewarded for returning tags to Dr. Carr.

After laying her eggs and being tagged the turtle shuffles to the sea. Returned tags indicate her destination might be waters off Nicaragua, Cuba, or the Yucatan peninsula.

around and go back. Once satisfied that she has made the right selection, a female will come ashore three to six more times during the season, at 13-day intervals. Each time, she uses her hind flippers to dig a pit about two feet deep. Each time, she lays about 100 golf ball-sized eggs.

Fleets of green turtles used to come ashore like this on beaches all over the Caribbean and Gulf of Mexico area. From Bermuda to Trinidad, Florida to Panama, the succulent reptiles and their eggs were plentiful and served as food for sailors, slaves, and colonists alike. For 300 years after the arrival of Columbus, all activity in the New World tropics—exploration, colonization, buccaneering, and even the maneuvering of naval squadrons—was in some way or degree dependent on turtle.

"The green turtle had all the qualities needed for a role in history," Archie Carr writes in his eloquent book *The Windward Road.* "It was big, abundant, available, succulent, sustaining and remarkably tenacious of life. Like the buffalo on the western plains, it stayed in one place and grazed on rich pastures of submarine grass, turning them into good savory meat . . ."

But under pressure of unrelenting exploitation, one by one the nesting haunts of the green turtle became deserted. First it was Bermuda, next the shores of the Greater Antilles, then the Bahamas and Florida, where turtle crawls once were more common than hen houses. Charles Peak caught 2,500 greens around Sebastian, Florida, in 1886; in 1895 he could find only 60.

Today, the last important nesting ground in the western Caribbean is a 22-mile stretch of beach along Costa Rica's east coast. Turtles still survive here because of the isolation. It requires three trains—one of them drawn by mules—and an eight-hour argosy in an outboard-powered dugout to get from the mountain capital, San José, to the strip of beach between the Tortuguero River and the thundering edge of the Caribbean. At the urging of Archie Carr, the Caribbean Conservation Corporation (CCC), successor to a group of philantrophists known as the Brotherhood of the Green Turtle, the Costa Rican government set aside the entire 22 miles of beach as a breeding refuge.

But insatiable new markets exist for turtle meat, eggs, calipee skin, and shell. Americans are learning that the dark, vealy gravy that masquerades under the name "turtle soup" is inferior to the clear, savory broth, for which there is demand in continental Europe and England. The body and soul of good turtle soup is calipee—the yellowish cartilage under the belly shell—and a Creole or Mosquito Indian can make a week's wages by slicing a few pounds out of a single turtle. Ads are appearing in newspapers from New York to Houston touting the appeal of turtle skin accessories for men and women, and natural tortoise shell is becoming more popular than plastic imitations.

These economic facts of life are hard on turtles. Wandering along the beach at Turtle Bogue during the day, I often came upon the slaughtered, dissected corpses of mothers who, before they could lay their eggs, had fallen prey to poachers. I listened to old men in the villages tell about times when there were so many turtles you could walk for miles on their backs. Yet, I sometimes patrolled the beach all night without encountering a dozen greens.

Establishment of conservation laws throughout its range would help the green turtle in its plight. But as Professor Carr points out; "To protect an animal you have got to know where it is—not just once in a while but all the time." This is where the tagging program comes in. It has revealed a lot about the migratory habits of green turtles, but the picture is far from complete. Hindering conservation work is the fact that little is known about the life history of greens from the time they are hatched until they appear off natal beaches as mature adults.

To fill this gap and to go far beyond conservation laws to save this gift of the sea from extinction, the Caribbean Conservation Corporation has joined forces with the United States Navy in Operation Green Turtle. This is a complex plot to trick the reptiles into thinking they were born someplace where they were not.

Eggs from a short section of the Tortuguero beach are dug up and transferred to the wire enclosures of a hatchery. After two months' incubation in the sun-warmed sand, the eggs hatch and the silver dollar-sized babies scratch their way to the surface. Those on the open beach must dodge a host of predators, including crabs, vultures, and gulls, and make their way to the surf. Those born in the hatchery are shielded from such enemies, and they fly before they swim. A United States Navy seaplane—a Grumman Albatross—from Roosevelt Roads, Puerto Rico, lands on the Tortuguero River in September. The airplane annually transports thousands of turtles to some two dozen shores and islands in the Caribbean and eastern Atlantic. Here the young are released on beaches, some of which were once populous nesting grounds. If predators are numerous, the turtles are turned loose about a half-mile offshore.

In September and October 1966, Operation Green Turtle introduced some 5,200 turtles into waters off British Honduras, Mexico, Colombia, Trinidad, Grenada, Barbados, Antigua, Jamaica, the Bahamas, Florida, and Texas. Carr and colleagues hope the young turtles will be imprinted with the smell, sight, taste, or feel of these release sites and will return there to mate as adults rather than going to Turtle Bogue. If the turtles do this, new breeding colonies will be established all over the Caribbean, providing a much needed source of protein to overpopulated, undernourished areas.

Is the plot working? It appears as if it is, but no one is quite sure yet. The Navy has been in the turtle transport business since 1961, but this may not be long enough. Archie Carr says, "There is the possibility that the project has not been underway long enough for the hatchlings of the first season to have matured. Perhaps it takes as long as eight years for turtles to mature, instead of four or five as we once thought. Then again, they might all be going back to Tortuguero or maybe predators eat most of them before they reach mating age. While we have no clear evidence of the successful establishment of nesting activity at any of the reintroduction sites, there is no doubt that some of the hatchlings are remaining in the vicinity of the places where they have been released. It can be hoped that some of these will eventually establish resident breeding populations."

There are other results, too, to keep the turtle alliance from becoming discouraged. According to Professor Carr, "An awareness of conservation problems is increasing among people who have thought little of such matters in the past. Concern over the plight of marine turtles has risen markedly in areas in which it never existed before, and in some of these, the governments have initiated sea turtle projects of their own." In Mexico there is strong interest in *Chelonia.* Off the Yucatan peninsula, on the Isle of Women, Operation Green Turtle has stocked a "turtle ranch," and two young biologists are trying to raise the reptiles like sea-going cattle.

Other turtle ranches have been started in Grenada, the Bahamas, Florida, and Texas. In 1966, hatchling stocks were flown to these sites as well as to Everglades National Park and to a 20-mile strip of protected beach at Cape Kennedy, Florida. Turtle culture projects are now in operation at Naples on Florida's southwest coast, at Islamorada in the Keys, at Key West, and at Rockport, Texas. "All of these are small, experimental operations," says Professor Carr, "really just tests of growth potential under various pen and feeding conditions. There is as yet nowhere in the world a real commercial venture in turtle culture."

Whereas only one young turtle in a thousand survives to maturity in nature, on the ranches virtually all hatchlings should reach adulthood. The oldest and largest ranch is a collaborative venture of the CCC and the Bahamas National Trust at Great Inagua, Bahamas. Some of the turtles that grow to maturity here are released in the hope they will establish breeding colonies in the vicinity. Others are kept to breed in coral-enclosed seaweed pastures. Together the two groups should supply enough hatchlings to stock other ranches.

Archie Carr believes commercial ranches offer the only hope of saving the green and its sea-going relatives, the hawksbill, ridley, and leatherback turtles. He feels that successful ranches would take the pressure off wild

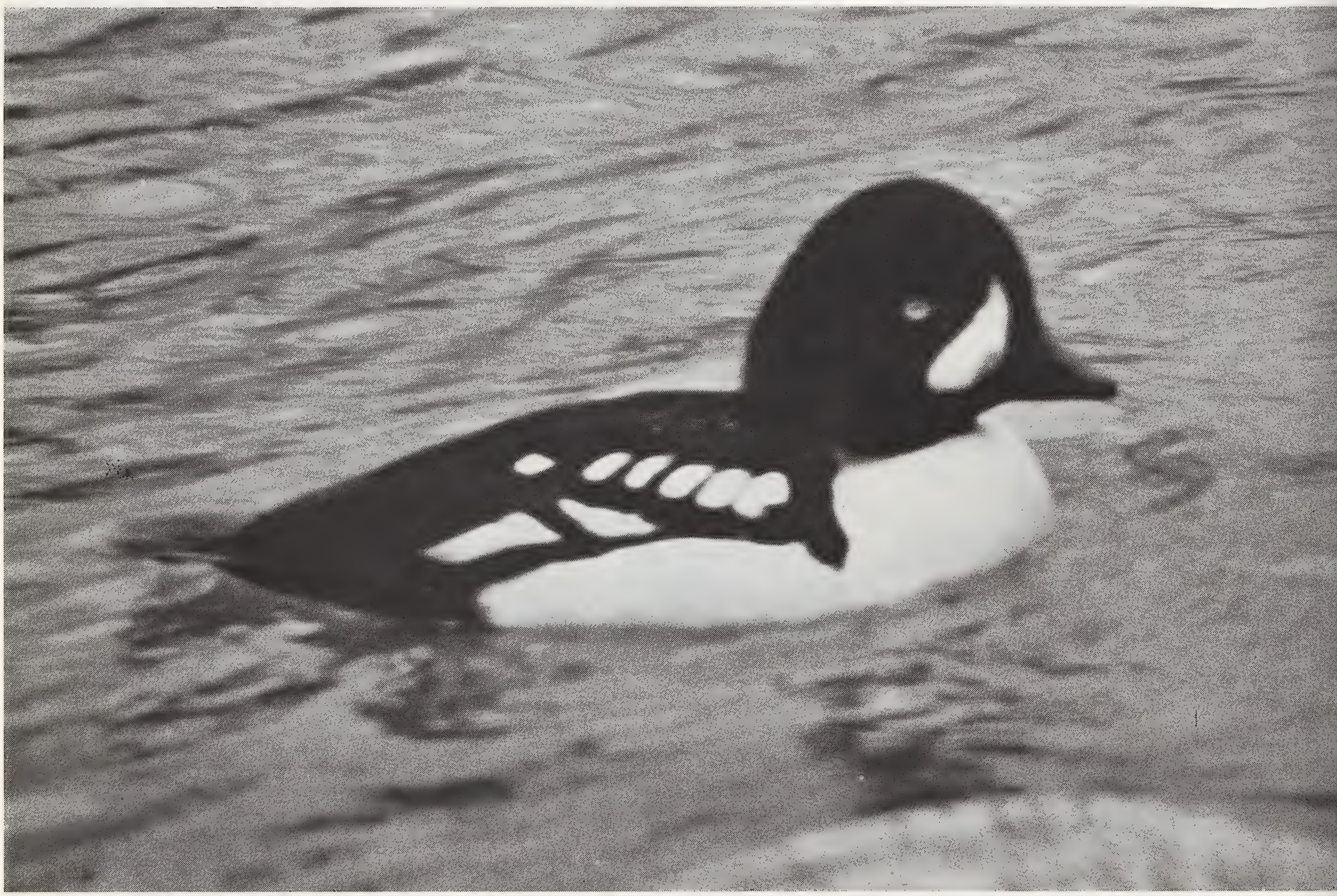
Turtle eggs are transferred to the wire enclosures of a hatchery, where they are protected from predators. Dr. Carr inspects silver dollar-sized hatchings, born after two months' incubation.

Thousands of hatchlings are transported by Navy seaplane to beaches throughout the Caribbean and eastern Atlantic.

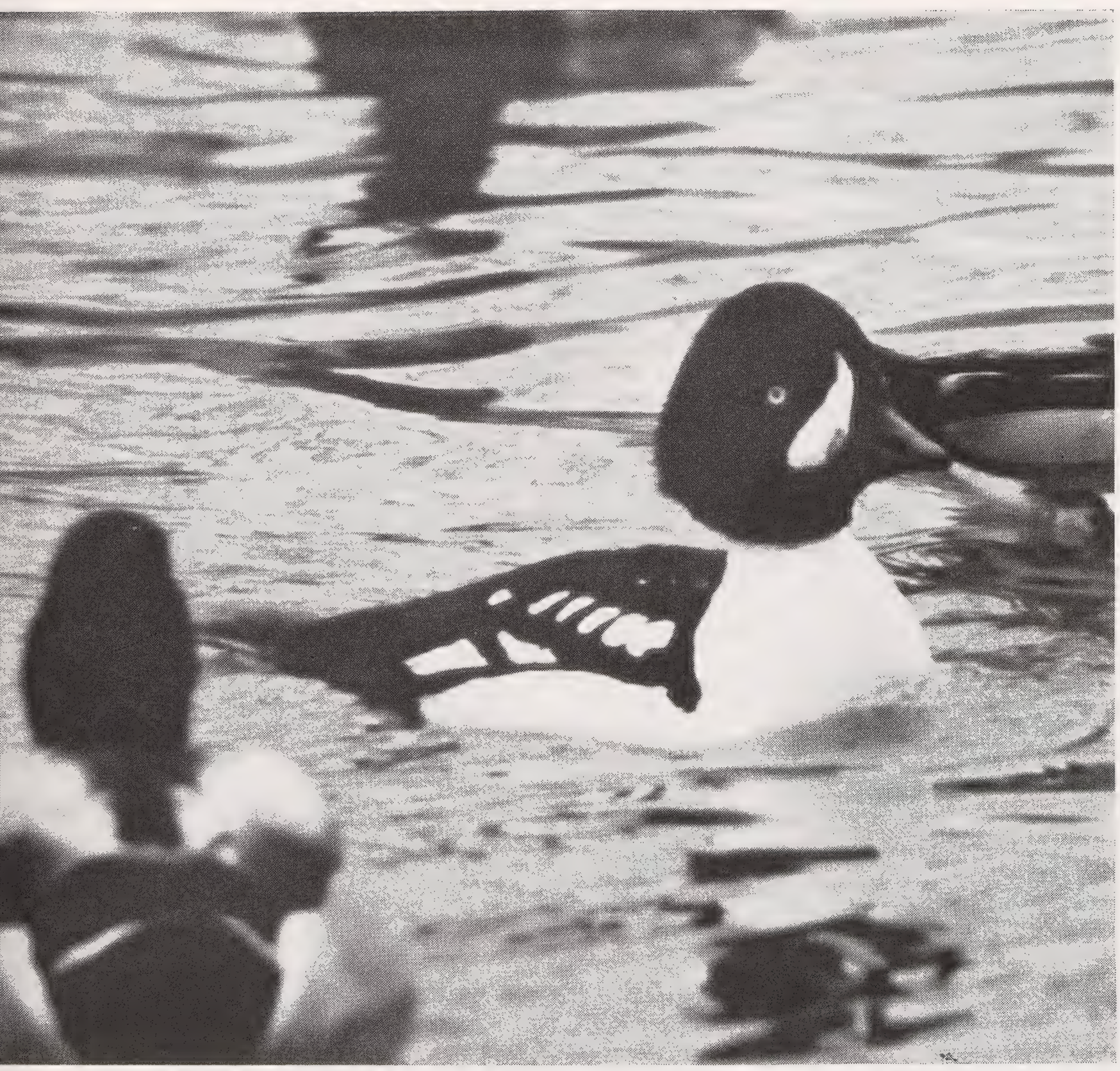
Hatchlings arrive in St. Lucia, where it is hoped that, as a result of imprinting, they will establish resident breeding populations.

stocks. They could also provide a new source of food and income in underdeveloped areas bordering on tropical seacoasts. Coupled with sensible and well-enforced conservation practices and the success of Operation Green Turtle, ranches would not only save *Chelonia mydas* but would go a long way toward restoring it to its former abundance. It is not too much to say that the green turtles can make a large contribution toward loosening the cruel grip hunger holds on over half the world's population.

Part II—"Adventures" will appear in the next issue.



Duck Displays



by

Jack and Inger Bradbury

THE MALE GOLDENEYE DUCK is a striking bird. His full breeding plumage is a bright patchwork of black and white, which he can puff up or sleek down to give a variety of piebald effects. As he darts about the pond, he performs a series of postures, or displays, that seem to accentuate this patterning. Each of these displays is a signal to other members of his species and serves both to capture the attention of the other birds and to communicate some message. The intended message may not always be clear to human observers, but the displays rarely fail to attract attention. In one typical display the goldeneye stretches his neck and head high, sleeks his plumage tightly against his body, and streaks across the water, calling softly. If he encounters another male goldeneye, he stops, fluffs the bright plumage of his neck and head, and takes several drinks of water. Then, with a snap, he stretches his neck flat out over the water, all the while pointing his bill toward the rival male. After a moment, he jerks back to the fluffed posture and paddles in quick circles. The performance ends as he flips his head onto his back and kicks up a small jet of water with his feet.

Early each spring, the waterfowl ponds of the Bronx Zoo erupt into just such a frenzy of splashing, chasing, leaping, and calling. Although many birds have been "displaying" throughout the fall and winter, spring is the season when they perform with an earnestness absent during the winter "warm-up." For even the most casual zoo visitor, this general state of activity is hard to miss. But few visitors take the time to sort through the apparent free-for-all and focus on the complex series of movements that the birds execute time and again with extreme rapidity and precision.

For several of us at the Institute for Research in Animal Behavior, the displays of waterfowl hold a particular interest. Part of this interest stems from the importance of displays in theories of animal behavior. Behavior, after all, is a branch of biology, and we are inclined to ask the same questions about patterns of behavior that other biologists ask about organs or cells: What are their functions? How are they modified by evolution? How do new ones arise? For many behavior patterns, these questions are difficult to answer; one cannot trace the evolution of a pattern that is so random that it varies as much in the same individual as it does from species to species. Instead, one needs a behavior pattern that is discrete and predictable. One can then correlate its occurrence with the context and hope to determine its function. If the same pattern occurs slightly changed in different but related species, we can hope to argue that the differences are evolutionary adaptations and not just random fluctuations.

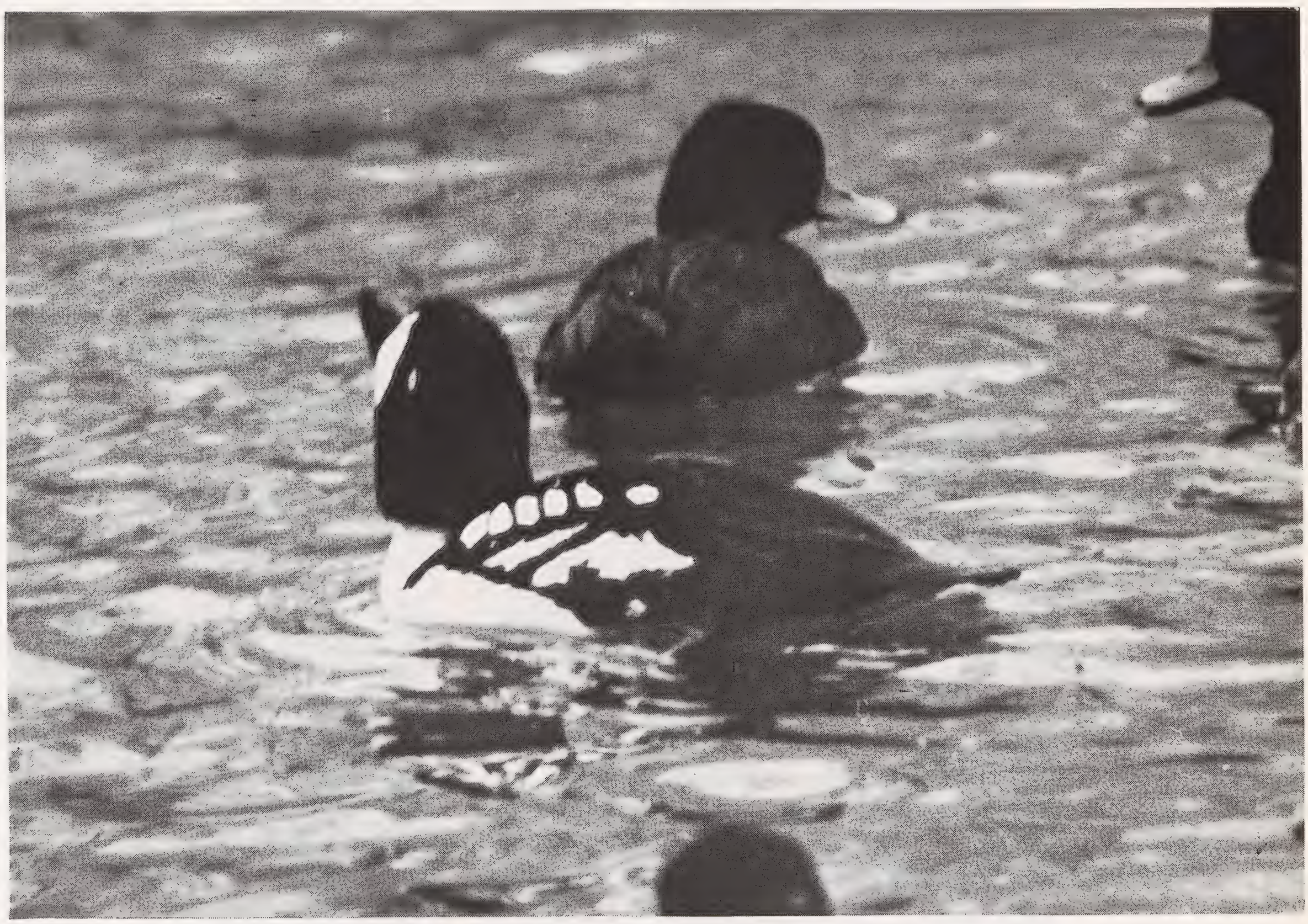
One of the most useful units of behavior for such studies has been the display. Displays are signals between individuals that are usually stereotyped both in format and in context. Presumably this stereotypy ensures that all members of a population will be able to understand the import of the signal. In waterfowl, the use of displays is particularly important to the normal breeding and territorial behavior of the birds. Not only are waterfowl displays highly stereotyped, but each species has several displays, each presumably communicating a different message. Male ducks, for example, use one set of displays to threaten other males during competition for territories or mates. They use a different set when attracting or courting females, and the female, in turn, performs another in affirming a pair bond. Just prior to copulation, both members of a pair perform jointly still another display. With such a large repertoire of highly stereotyped patterns and with over 200 species scattered over the world, waterfowl make an ideal group for comparative studies of behavior.

Last spring we initiated a small study to photograph and observe the displays of the ducks, geese, and swans in the zoo's Marsh Garden. We placed a 6 by 3 by 3-foot rectangular blind on stilts over the water of the pond and adjusted its height so that an observer inside could photograph the birds at water level. This was important, as many displays lose their effect if seen from an angle other

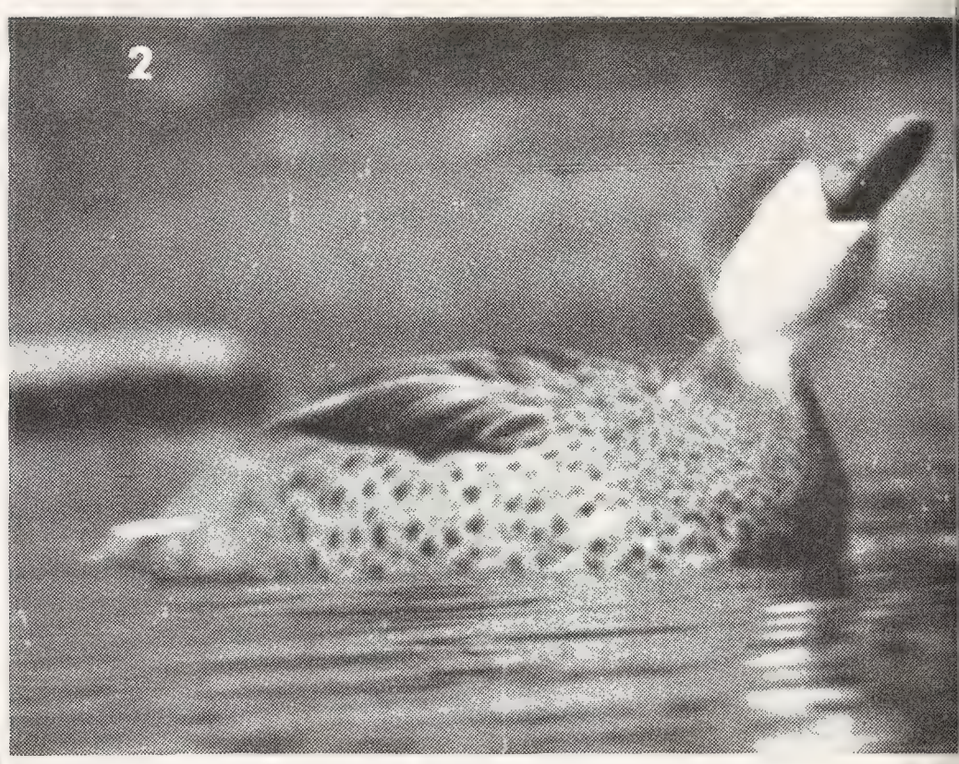
than the "duck's-eye view." The presence of the blind did not seem to bother the birds. On the contrary, the rare Laysan teal were very curious about this "giant nesting box" and spent an inordinate amount of time nibbling the edges and peeping in the camera hole.

After watching the birds for several hours, an observer cannot help but be impressed by the many different display patterns. Some displays are very vocal; others are performed in complete silence. Some seem to call attention to bright iridescent parts of the plumage; others rely on the form of the movements alone. Many displays are remarkably conspicuous and spectacular; others are very subtle. An example of the spectacular is the "triumph ceremony" of trumpeter swans, which usually follows a territorial squabble between males. As soon as the victorious male has chased off the intruder he stretches his neck and wings and returns trumpeting to his mate. The female assumes the same posture and for several minutes the pair face each other and trumpet loudly.

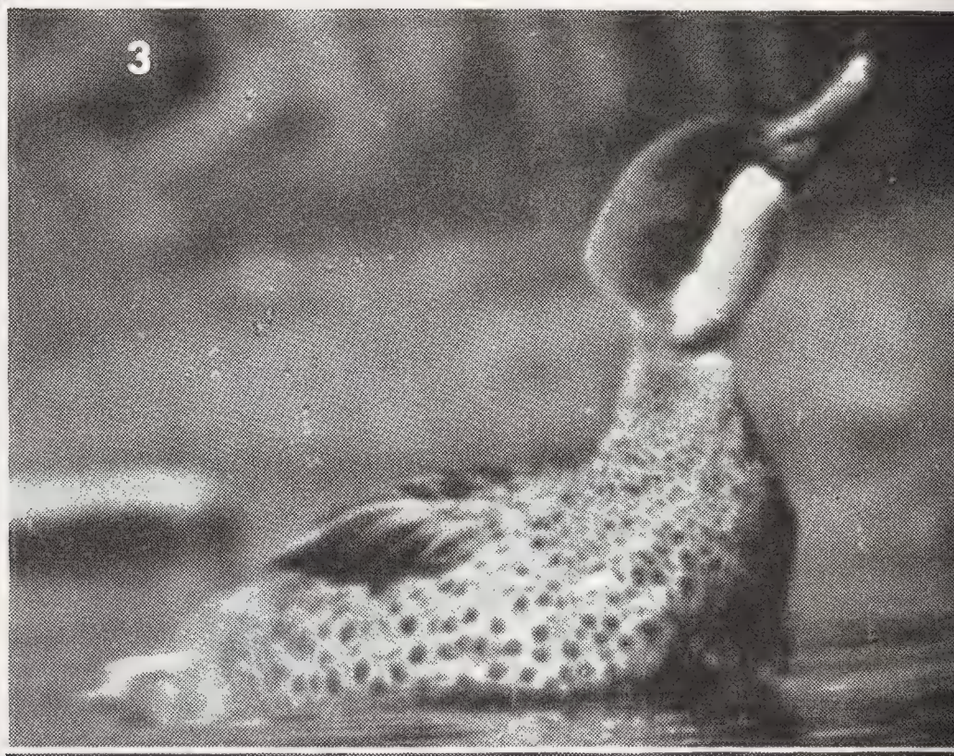
Equally remarkable is the behavior of the male Argentine ruddy duck, which we observed during the study. This smallish bird is an active swimmer and is usually seen scooting about the surface or diving, lightning

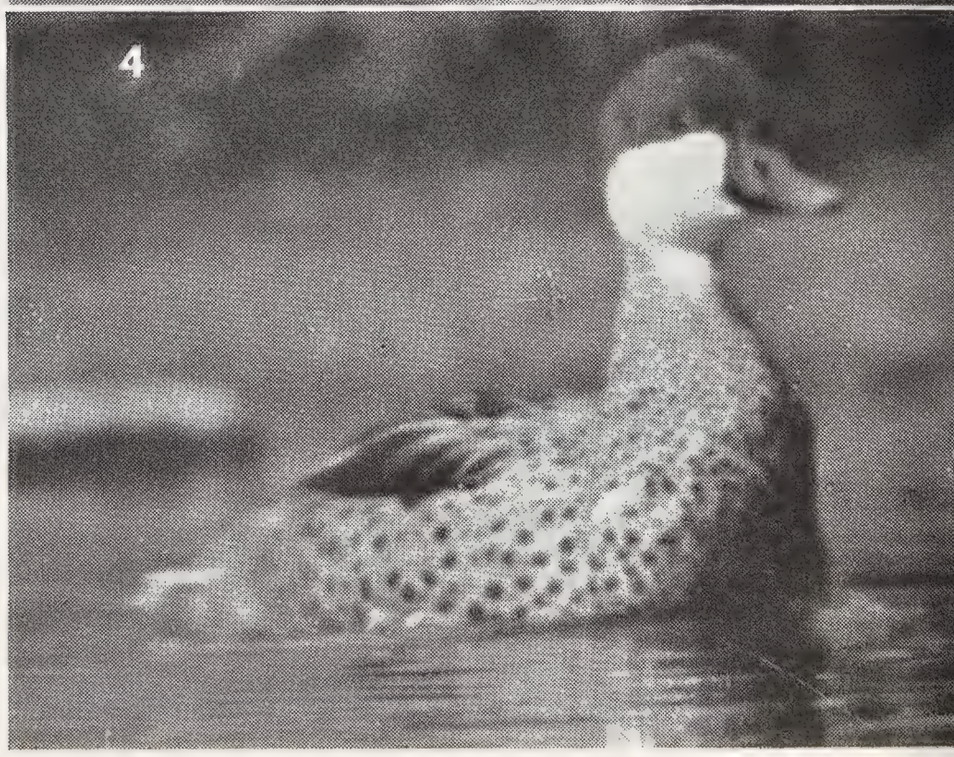


Page 12: A male Barrow's goldeneye sits in a relaxed position. His crest is flat against his nape and his neck is withdrawn. Page 13: The same male Barrow's goldeneye performing a display in which the crest is now erect, the neck is stretched upward, and the bird is calling softly. Above: A male Barrow's goldeneye begins a "head-throw" display. In the following instant the head will be laid on the back with the bill pointing upward, and the feet will kick up a spray of water.


2

1


3


4

The separate steps in a display of the Bahama pintail can be seen in these high-speed photographs. The sequence begins with the bird in a relaxed position (1). He soon performs a "preliminary shake" of the head, first with a swing to the right (2), and then a swing to the left (3). He settles back to the water (4) and then may sit quietly for several seconds (5). In the next stage, he rocks forward on his breast, raising his tail high, and exposes several brightly colored feathers on his wings (6). This is called a "down-up." With great rapidity, he stretches both neck and tail upward to establish the "head-up-tail-up" position and simultaneously whistles (7). The display ends as he settles back into the water.

quick, under the water. Periodically, the male under observation would stop his scooting and jerk his head as if suffering from hiccups. These vertical jerks then merged into a general forward-and-aft rocking of the whole body. At the same time, air sacks in the neck and breast were inflated and the nape plumage erected. The bird rocked violently in this condition for 10 to 20 seconds, then relaxed and began scooting about the pond again.

An example of a more subtle display is "ritualized drinking." It is not obvious at first that some drinking actually is a ritual. The movements involved in ritual drinking are in fact the same as in ordinary drinking: the bird dips its bill in the water, then raises it for several seconds as if swallowing. Only after actually counting the number of times a duck drinks in, say, an hour does one wonder if all that water is really consumed. Furthermore, drinking seems to follow certain other activities with a distinct regularity. In the Garganey teal, each of the obvious displays is followed by a drink or two. Drinking also follows encounters between rival male Garganeys. These ducks often display in small parties, so there are frequent confrontations between competing males. Battles, however, are almost never observed. Instead, both parties take a good ritualized drink. Presumably this is a signal between rivals that no attack is intended.

Often, a display pattern includes both conspicuous and subtle elements. In the male Bahama pintail, for instance, the conspicuous display is the "down-up-head-up-tail-up." This begins with the bird rocking forward on his breast and elevating his rump high out of the water. As the bird rocks back, the head and tail are simultaneously stretched upward and a whistle is emitted. What is inevitably missed without extensive observation is that this sequence is always preceded by a general shake of the body. This "preliminary shake" is exactly the movement that the bird uses to rearrange his feathers after preening. Only after paying close attention to the sequence of these activities is it possible to decide whether a shake is part of a display or not.

While this apparent difficulty in distinguishing between displays and other activities has hindered descriptive studies, it has been a boon to those interested in the origin and modification of displays. It was precisely this similarity that prompted Konrad Lorenz, the pioneering Austrian ethologist, to suggest that the daily activities of shaking, preening, and drinking were the raw materials from which some displays were derived. This suggestion has led to the idea that display behavior may evolve just as morphological structures do. A new display might arise over a long period of time if an existing activity, such as shaking of the body, were to acquire some value as a signal between birds. As variations in this display occur, those that increase the breeding success of the displayer would have an advantage in natural selection. Thus, with time, a display could become less like the activity that gave

One display of the male marbled teal consists of stretching the neck upward for several seconds (page 18) and then snapping the head onto the back (above). A shake often follows this display, in contrast to the Bahama pintail, which shakes before its display.

rise to it and more and more an independent set of signals. In this view, ritualized drinking and preliminary shakes would be early stages in the process of display evolution. The complex displays of the Bahama pintail, which no longer resemble any other functional activity, would be more highly evolved. Much of the present research aims to clarify this evolutionary process.

Aside from the evolution of displays, the problem that most concerns many of us is the function of displays. Unfortunately, the enormous diversity in the content and context of waterfowl displays has made it difficult to generalize about their function. However, the work that has been done suggests the following possibilities.

The ritualized drinking of the Garganey teal presumably serves to prevent overt battling between rival males. This has obvious advantages for the species because it allows competition to occur without resulting in bodily injury to any of the competitors. Such ritualized alternatives to fighting have also been described for other animals.

Many displays, such as the down-up-head-up-tail-up of the Bahama pintail are harder to explain. It is probable that these activities serve several functions simultaneously. In species that pair in regions frequented by other waterfowl, the unique display repertoire of each species may aid in the location and selection of a correct mate.

Displays may also be important in establishing an even distribution of breeding pairs over the nesting grounds. This would increase the chances for survival of the young. Female displays probably serve to inhibit male territorial aggressiveness; otherwise the members of a pair could never get close enough to mate. Finally, these activities may be important in synchronizing the hormonal changes that occur in both the male and female and are so important for successful reproduction in birds.

The Bronx Zoo is an ideal place to watch waterfowl displays, whether from a professional or from a casual point of view. The collections are large and healthy, and the birds are tame enough to make observation easy. One needs no equipment, only time and patience. For those interested, the period of greatest activity occurs in the spring, although the fall is also good. The better times of day are the early morning and the late afternoon. It also helps to know what to look for. Unfortunately there is no satisfactory field guide on the subject, but the *Handbook of Waterfowl Behavior* by Paul Johnsgard is helpful in identifying most displays.

Barrabea –a mammal that hatches

by John Hillaby

THE ABORIGINES CALL THEM *barrabea, bulla-bullen,* or *ningan* and say they taste good, boiled or roasted. Menagerie keepers refer to them as spiny anteaters or echidnas and keep them alive on milk, finely minced meat, and mealworms. The Latin generic name of this very curious group of animals is *Tachyglossus,* meaning rapid tongue. Together with the related duck-billed platypus they are considered to be amoung the oddest of the Australasian fauna. They are entirely on their own. The few fossils that have been found go back for about a million years. (The animal may be older, however—Ed.)

In a hot dry part of central Queensland recently, Harry Frauca, an animal collector employed by Monash University in Melbourne, saw the tip of the curved snout of a baby *barrabea* sticking out of the ground and promptly dug it up. He popped the animal into his billycan and sent it back to Monash by air. The label said: "Handle carefully." Echidna spines are thought to be infected with microorganisms that sometimes cause intense irritation. The animal is now being subjected to physiological tests in an effort to find out how it copes with temperatures that generally prove fatal to other forms of warm-blooded life.

Heat conservation and regulation are characteristic features of mammals. But echidnas are monotremes, or one-vents: they just manage to qualify as mammals. The posterior end of the echidna's intestine and the excretory and genital ducts open into a common chamber, the cloaca, as in reptiles and birds.

The females lay a single, large-yoked, leathery-shelled egg, which remains in an abdominal pocket until it hatches.

In many respects, especially stance, eye structure, the presence of certain bones in the skull, and the general configuration of the

shoulder girdles, the monotremes are more closely related to the reptiles than any other recent mammals. Mammalian features include the single bone on each side of the lower jaw (not several, as in reptiles) and three middle-ear bones rather than one. They represent a distinct yet parallel form of evolution and not a bridge group between the warm- and the cold-blooded. They apparently are not related to anything except the other monotremes.

Until Linnaeus coined the word "mammal" — or rather its Latin equivalent, *mammalis* — there was no word in any of the European languages to denote animals that have hair and suckle their young. In these respects echidnas qualify for mammalian status. Milk oozes from the females from paired areas of tubular glands.

Their most noticeable external characteristics are a long slender snout and a defensive armory of spines, which are, in fact, specialized hairs, usually large, hollow, and thin-walled. In some individuals the brown or black body fur is almost concealed by the spines, but in the Tasmanian species the short spines are largely hidden by the fur.

As might be expected, spiny anteaters are not as clean as their aquatic cousin, the platypus; their spiny coats make it difficult for them to clean themselves by the usual mammalian method of scratching. To get around this sanitation problem they probe about the spines with a greatly extended curved nail on their big toe.

Food is obtained by rapid flicking movements of a long sticky tongue, to which ants, termites, and other small insects adhere. Some tribes of aborigines hunt the animal with trained dingoes and say it makes a very tasty meal. But to enjoy echidna for supper Ellis Troughton, a distinguished investigator, says that first you have to develop a liking for the strong flavor of formic acid. He came to this conclusion after eating some scones fried in their fat. He considers this to be one of the most bilious and trying experiences to which an inquiring mammalogist can be subjected by an experimenting camp cook.

Echidnas are generally solitary. They are also powerful and fast diggers, burrowing straight down with remarkable speed. Refuges include hollow logs, cavities under roots and rocks, and burrows. Like the hedgehog's, the echidna's spines can be erected and the limbs withdrawn. Once they wedge themselves into a crevice in this position it is almost impossible to get them out.

To give some idea of the strength of the little creatures Professor Wood Jones cites the experience of an Adelaide zoologist who ill-advisedly shut one up in his kitchen overnight. In the morning he discovered that the heavy dresser, the table, and some chairs and boxes had been shoved away from the walls toward the center of the room. Only the fixed gas stove withstood the efforts of the animal to move it.

Although the echidna is clearly warm-blooded, its average temperature is rather low compared with that of other mammals. Reptiles are often spoken of as cold-blooded, but the term is somewhat misleading because a cold-blooded lizard on a rock on a hot day may have a higher temperature than a warm-blooded man. Mammals have the ability to stabilize their temperature by many means—an insulating layer of hair, sweat glands that differ greatly in their distribution among different species of animals.

In man and the rabbit, for example, they are found virtually everywhere in the skin. In carnivores, especially dogs, they are thinly distributed on the general surface: the principal heat shed takes place on the nose, tongue, mouth cavity, and foot pads.

Monash investigators suspect that in the most exacting parts of the echidna's range (there are five different kinds of echidna) the animals have evolved special sweat glands that, combined with their burrowing abilities, enable them to survive the heat. Perhaps a low rate of metabolism helps. Like some reptiles, they can survive without nourishment for periods of up to a month. One captive specimen lived for more than 50 years and another for 21. Perhaps they survive even longer in the wild, for man is apparently the only enemy of these fascinating little animals.

THIS IS THE SECOND OF
TWO ARTICLES ON THE PRIMATE
COLLECTION OF
THE OREGON REGIONAL
PRIMATE RESEARCH CENTER

STAN FEDERMAN

AN

ORDERED SOCIETY

Life in a Macaque Troupe

THEY HAVE PLAYED a major part in the mythology, history, and folklore of Japan. Three of their tribe have been immortalized forever as the trio who "sees no evil, hears no evil, and speaks no evil."

"They" are Japanese macaque monkeys—a species that now is under intense scientific scrutiny at the Oregon Regional Primate Research Center, just outside Portland.

Some 70 Japanese macaques are currently the object of various scientific observations at the center's new two-acre outdoor "monkey corral." The macaques constitute the only "natural" troupe of their kind outside Japan.

The corral is a "first" at the noted primate center—and is believed to be the only one in America and the largest of its type in the entire world. It was built especially for the macaques, which came to the center in May 1966 as a gift from the Japan Monkey Center at Inuyama.

Macaques are protected under Japanese law —except when they become a nuisance to farmers and cause crop damage. Then such marauding troupes are hunted down and captured. This was the case of the Oregon troupe, which was taken intact in the Hiroshima prefecture while romping through a favorite field. A large cage containing foods preferred by the

macaques was placed in the field by Japanese primate experts—and every member of the troupe was enticed into the cage and captured.

The troupe at the Oregon center includes 13 babies born last spring in the corral. The original troupe from Japan totaled 59; two have since died.

The macaques are of the subspecies *Macaca fuscata fuscata,* found throughout the islands of Japan with the exception of Yakushima and Hokkaido. Another subspecies, *M. fuscata yakui,* is found only on Yakushima.

The number of Japanese macaques is fairly small; there were about 26,000 in 1947, the year they attained protection under law. They are nomadic, and in the wild bands of a dozen to 200 individuals range from the evergreen forests of southwest Japan to the snowy deciduous forests and mountains of northern Honshu. These Japanese monkeys are very rugged animals and quickly acclimate themselves to changing weather conditions. The macaques at the Oregon center have the freedom of the institution's corral. They have remained outdoors in the corral with only a minimum of shelter.

The corral is fenced in by heavy galvanized corrugated sheet metal walls, which are 11 feet high. Although powerful animals, the macaques are unable to jump over the fence—and there have never been any escape problems.

In the center of the corral is a two-stage platform, on which the animals sleep and often play. Around the platform are scattered low piles of rocks and several large tree stumps and posts, which provide the monkeys with a place to climb. The troupe has established this center area as its special "territory"—and woe to anyone who ventures near it.

The center's anthropologist, Dr. Theodore Grand, spends at least two hours daily studying the troupe's social behavior patterns from one of the corral's observation towers. He reports that the monkeys usually spend as much time looking up and observing him as he does looking down and observing them.

Center scientists have noticed that the macaques show no signs of typical caged behavior in the corral although they appear to be changing patterns of behavior usually associated with the wild. Observers note that, above all, the troupe seems to realize that it is safe from predators and that food is freely provided. The result is that the monkeys spend a great deal of time simply playing and "enjoying the good life."

One male dominates the troupe's social order—the alpha male, as he is known at the center. He is the king, the leader, the quarterback, and the jury foreman—all rolled up into a very large, powerful creature. When he walks through the corral, the other monkeys maintain a respectful distance. When the center serves dinner of monkey chow and biscuits, the alpha male eats first.

The alpha male surrounds himself with a group of dominant male lieutenants and three or four dominant females, one of whom is always his special favorite. The lieutenants appear to carry out his orders, supervise the troupe—and even mind the babies at dinnertime.

The troupe is very protective of its young, and one of the lieutenants is the official "baby-sitter." When apples are tossed into the compound, for instance, the dominant male gets one, as do the favorite female, the male lieutenants, and any new mothers. The baby-sitter positions himself squarely among the apples to make sure no mature member steals one from a baby. Sometimes, however, an older macaque tests the system, snatches an apple from a baby, and scurries off—cradling the apple like a football in one arm and attempting to ward off the baby-sitter with the other arm.

Japanese macaques usually walk on the palms of their hands and flats of their feet, with a slumping gait. But they can shift into the monkey equivalent of high gear—somewhat of a gallop. However, as fast as the apple thief moves, the baby-sitter stays right with him and eventually, in despair, the thief drops the apple. The baby-sitter will pick up the apple, chatter angrily at the thief, and then eat the fruit himself.

Although there are some predatory birds such as owls and hawks in the area of the corral, none ever come near the corral enclosure,

for the Japanese macaque is a formidable foe. The adult males are heavy-shouldered, muscular animals who measure about two feet from crown to rump—but appear much larger because of their thick fur. They have razor-sharp canine teeth, and a gang of macaques is fully capable of killing many a larger creature – including man.

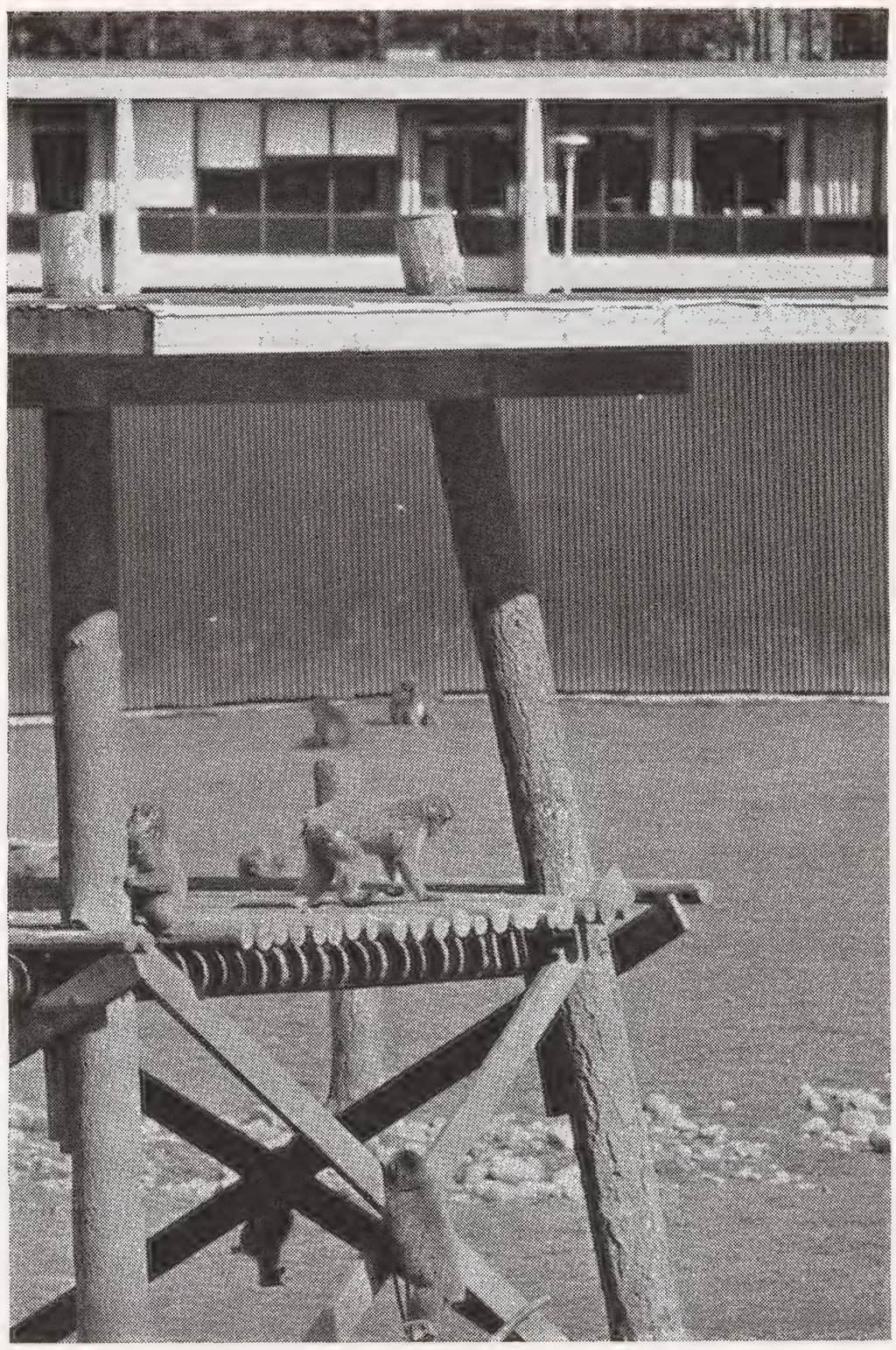
All Japanese macaques can be aggressive animals; it is part of their personality. Delightful little clowns as babies, they often become increasingly crotchety and dangerous as they mature.

They express their aggressiveness in three basic physical attitudes. First and mildest is the "stare"—a hard look serving to intimidate a foe. If the stare fails, the macaque adds extra menace by opening its mouth and displaying its teeth. If the target is still unimpressed, the last and presumably the most terrifying gesture reinforces the facial threats—a bobbing up and down of the head. The target then should be prepared to flee or fight.

The Japanese macaque has a long, soft coat of gray-brown fur. Its tail is small and flattened. A prominent nose distinguishes a pink face, which may turn brilliant red when the macaque is excited or angry. Japanese macaques produce a variation of sounds, ranging from a single whoop to a gutterul screech.

Observers have noted that although there is a single ruler within the troupe, aristocracy for the macaques is not permanent. One of the intriguing aspects of the troupe's social life is that the dominant males form a ruling clique that allies them against all outside threats. Troupe order is thus preserved by the discipline of collaboration. Daily life in the corral is normally peaceful—probably because every member of the troupe knows his or her place.

This does not mean, however, that there are not frequent struggles for "room at the top." But it takes an especially strong macaque to break into the ruling clique. Since the monkeys arrived at the center, only two have died —a remarkable achievement for the center, considering the complete change in the troupe's way of life. Interestingly enough, both losses



The macaques have established this two-stage platform and surrounding rocks, tree stumps, and posts as their "territory."

Group scrambles away from apples as dominant male approaches. Dominant male, favorite female, male lieutenants, and new mothers get first choice.

were intermediate males who challenged the dominance of the alpha male—and were killed by the rest of the ruling male clique.

The troupe deals swiftly and harshly with offenders. Relays of the troupe's larger males will chase an offender around and around the corral until the hunted one is worn out. When the victim stops to rest, the entire ruling clique then attacks. In the case of the two challengers, the verdict was death.

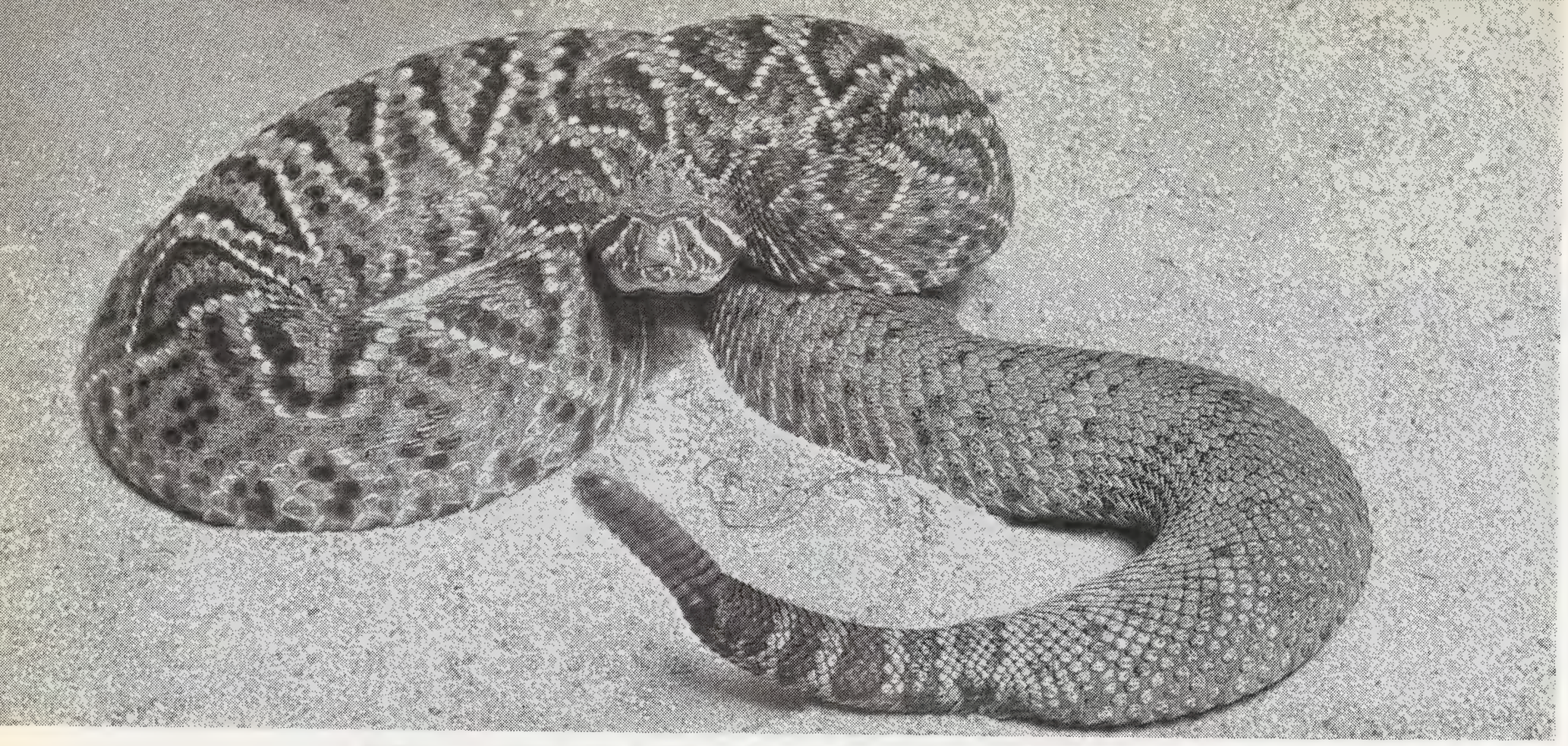
For most offenses, however, the ruling clique usually administers a sound thrashing to the offender. If one of the troupe is a repeated offender he may find himself cast out from the normal troupe activities for a period of time. The outcasts are usually easy to spot in the corral, for they carry battle scars and are ignored by the rest of the troupe. If they wander too close to a female they are quickly set upon by the dominant males and chased away to the farthest reaches of the corral. At dinnertime, when all the troupe has eaten its fill, exiles are permitted to sneak up and grab a biscuit or two—and then are chased off again.

The macaques mate in the early fall and have a gestation period of about seven months. Births usually occur in March and April. The troupe makes a great fuss over its babies. Infant macaques are most engaging, endlessly active, and born comics. They usually ride along with their mothers by clinging upside down from the hair of the adult's stomach. As they grow older, the infants abandon this position and attempt to ride the mother's back.

Although the troupe is quite noisy in the early morning, it calms down during the day, then becomes exceedingly active again in late afternoon around dinnertime. On moonlit nights, the animals are restless and noisy. They are much more settled on overcast, dark nights.

Of all their activities, perhaps none provides such an instrument of social harmony as the troupe's constant grooming. They obviously enjoy grooming and being groomed. Usually the animal being administered to will lie or sit in the attitude of absolute contentment, like a man enjoying a scalp massage at a barber shop. Most grooming is done by females. Dominant males get the most—and give the least.

Infant macaques usually ride along with their mothers by clinging upside down from the hair of the adult's stomach. As they grow older, the young macaques abandon this position and attempt to ride the mother's back.



WILLIAM M. PARTINGTON

FLORIDA'S DIAMONDBACK HOLDS ITS GROUND

FLORIDA BOOSTERS may not be anxious to promote it, but the largest species of poisonous snake in North America still thrives in that state. Many other creatures typical of Florida's past, along with certain colorful human characters and communities, are fast disappearing under the pressure of increasing population. Nevertheless the eastern diamondback rattler (*Crotalus adamanteus*) continues to show up regularly in most parts of Florida, appearing on back roads and in new housing developments, disturbing property owners who had been convinced by real estate agents that they could expect congenial neighbors.

The range of the eastern diamondback extends south from North Carolina along the coastal lowlands and stretches west to eastern Louisiana. The eastern diamondback is commonly three and one-half to five feet long with an accepted record size of eight feet. It is a thick-bodied snake at any length having a dorsal pattern of dark diamonds. Whether stretched out on the prowl or coiled up beneath some overhanging branch, the snake presents an impression of massive size and power that is intensified as soon as the animal is aroused. There is the sizzling rattle, arched striking coil of the neck, slowly waving tongue, and elliptical eye pupils peering from under supraocular scales that create the appearance of a frown. However, as rattlesnake authority L. M. Klauber says in his monumental volumes on these animals, a single encounter with a human is usually the rattler's only such experience. Most end up a lifeless trophy. Killing rattlesnakes seems heroic to most people, especially in our present age, when the opportunity to prove oneself against a very dangerous wild animal becomes increasingly rare.

Yet the diamondback is really a fascinating creature, the end product of millions of years of reptilian evolution and an example of an animal more deserving of protection in our disappearing wilderness than of persecution. The opportunity to observe this native animal far outshines the need to exterminate it.

Nevertheless, most people would attempt to justify the elimination of poisonous snakes near areas of heavy population, no matter what methods are used to remove them. Unfortunately, the diamondback typically inhabits places also favored for housing in central and southern Florida, such as the well-drained ridges or easily bulldozed pine flatwoods. In both these areas a characteristic native plant is the low-growing saw palmetto (*Serenoa repens*), which forms dense, forbidding thickets harboring other reptiles and the rattlers' favorite prey, rabbits and quail. Like most other palms, the saw palmetto is amazingly fire resistant. Its vascular bundles are distributed throughout the trunk and are not easily damaged, as are the peripheral living tissues of the pines and leafy trees. A flatwoods fire cleans out the underbrush and reptiles for a season or two, but the plants recover quickly

and again support the diamondbacks' prey.

Gopher tortoises also favor the remaining wild ridge areas, where they can dig tunnels 20 feet or more in length. These tunnels are notorious for sheltering diamondbacks (as well as that most common of pet snakes, the indigo). In the flatwoods an introduced newcomer, the armadillo, digs shallow burrows under the palmettos that are similarly used.

A most unfortunate feature of south Florida's flatwoods is its use by unappreciative persons as rubbish dumps. Piles of garbage, stripped cars, and old appliances have now become regular features that deserve some mention as characteristic microhabitats in themselves. All these artifacts soon attract rats, opossums, and other occasional prey.

Diamondback rattlers have few natural enemies or competitors remaining in many parts of Florida. The state's once numerous bears have been reduced almost to extinction and have ceased to be important predators. Bobcats are somewhat more common, but it is doubtful if one would attack an adult rattler. There appear to be few reliable records of deer or turkeys killing these snakes in Florida, and none of these persist as near to human habitations as the rattlers. Snakes of other species may compete with or feed on young diamondbacks, but it is doubtful if any other species affect the adults. The diamondback's closest relative in south Florida, the dusky pigmy rattler (*Sistrurus miliarius barbouri*), usually smaller than even "baby" diamondbacks, prefers wetter situations and certainly offers no competition.

Drainage projects in south Florida have probably helped diamondbacks in some places. Although these snakes are sometimes found swimming across cypress ponds, wet prairies, and rivers, they typically favor xeric (drier) areas. Vast sections of prairies and swamps that border on flatwoods are being drained, and palmettos, gallberry, and such exotic shrubs as guava and Brazilian pepper infiltrate the former aquatic communities. It would be difficult to judge, from a safety point of view, whether the wetlands that support cottonmouths are preferable to the drier flatwoods supporting diamondbacks. At any rate, it becomes apparent that human interference with wildlife and native habitat just beyond zones of intensive development has often contributed to the diamondback's welfare.

It should not be assumed from all this that snake hunters can readily depend on finding a diamondback in south Florida. These snakes have a habit of appearing and disappearing most unexpectedly. While I was on the staff of the Pine Jog Nature Center in West Palm Beach, on the edge of about 100 acres of pine flatwoods, diamondbacks showed up with fair regularity when most unexpected, offering a few surprises for visitors and staff.

During an ecology lesson in the woods one winter's day a coiled four-foot diamondback started buzzing from beneath a saw palmetto clump, providing a memorable experience for an elementary school class of 30 children. Accommodatingly, it waited until a rake was obtained to pull it out and was easily captured. Shortly afterward a dog belonging to an instructor was bitten nearby by what was probably a young rattler. Several times adult diamondbacks were found crossing the walks connecting the buildings, and one was even stepped on by a comparatively snake-shy, preoccupied educator who fortunately escaped with only shattered nerves.

Consequently, there was considerable concern that we should reduce our apparently thriving diamondback population. Two snake hunters with very successful records were invited to scour the woods, but a day's search revealed only harmless ringneck snakes. But 20 minutes after the disappointed collectors left, a young diamondback was found freshly squashed on the road just outside the nature center, undoubtedly driven out of some adjacent brush the men had been probing.

As you may gather from the foregoing, the diamondback's worst enemies at present seem to be automobiles, eradication of habitat by complete development of the countryside, and actual contact with man. Fortunately, for the rattler, it seems to be quite adaptable to some interference with native habitat and may be expected to provide the people of Florida with more material for tall tales for years to come.

animal kingdom
NEWS OF ZOOS, AQUARIUMS, AND CONSERVATION
REPORTS

Twin Orangs Born at Woodland Park Zoo

Twin orangutans, a male weighing 3 lb. 4 oz. and a female weighing 1 lb. 14 oz., were born to Molly and Elvis, 10-year-old orangs, at Woodland Park Zoo in Seattle, Washington, on February 19.

Personnel from the pediatric department of the University of Washington assisted in caring for the young orangs. The mother was unable to feed the babies and 19 hours after birth the babies were placed in an incubator.

Woodland Park Zoo personnel researched records back to 1956 without finding a case of twin births of orangs in captivity.

Takin Collection Increased

The Bronx Zoo has added a third takin to its collection, the only group of these rare "goat-antelopes" in the western world.

The new takin, a female about a year old, eventually will be placed with the zoo's other takins, a male and female.

The zoo hopes to breed these shaggy, horned animals. Successful breeding of takins in captivity is considered a major zoo event.

Although they appear clumsy, takins scamper about the rocks of their mountainous habitat with remarkable agility.

The Bronx Zoo's new female takin is shown here in a holding area. In their natural habitat in the mountains of southern Asia these shaggy animals live in groups of up to eight, except in summer, when they may form large herds.

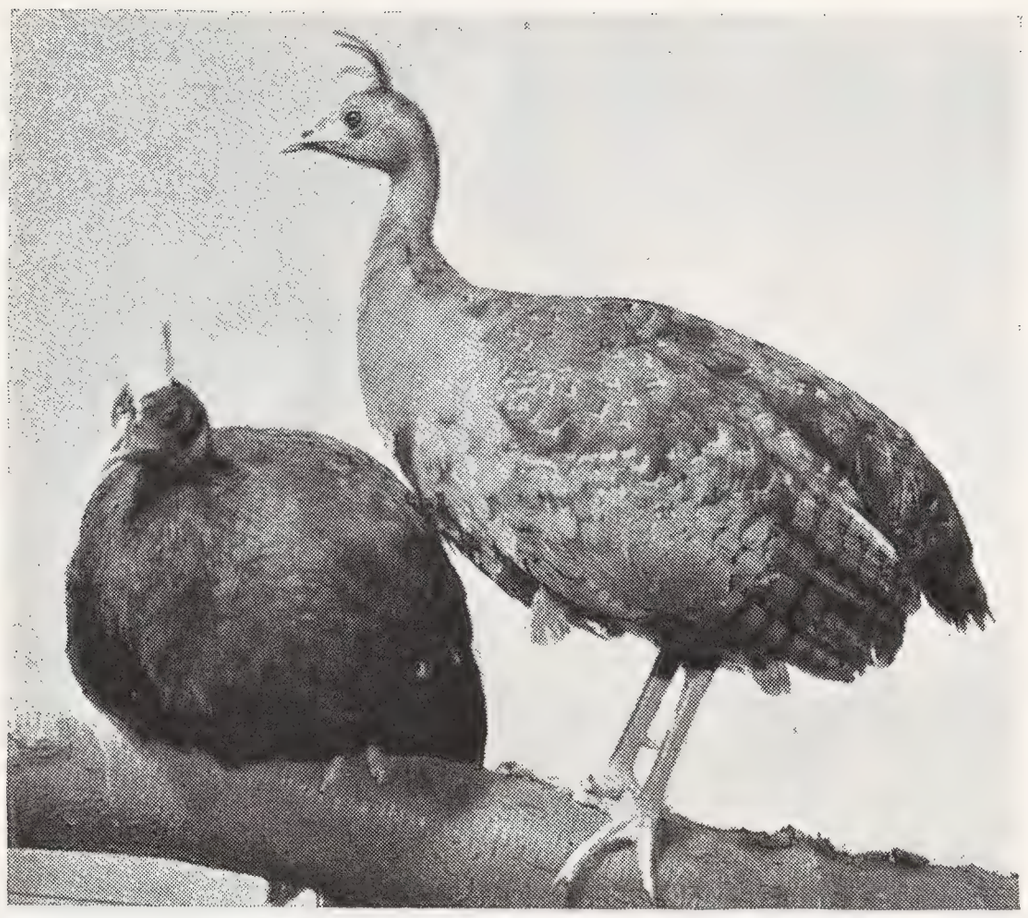
Whales Lose Bachelor Status

New York Aquarium's two male belugas —white whales—have lost their bachelor quarters. The males now share their 100,000-gallon tank with a pair of female belugas.

With the arrival of the females in September, the whale tank was halved by a wire mesh fence.

In January the fence was removed.

After several weeks, the fence was replaced in the tank. This time, however, the whales were paired off. Alex and the smaller of the two females now have the range of half of the tank, while Blanchon and the other female share the other half.



The male Congo peacock is blue and green with a crown of white plumes. The female on the other hand is brown and green in color.

Record Setting Congo Peacock Dies

When seven Congo peacocks arrived at the Bronx Zoo in June, 1949, their coming was marked by an appropriate stir. The large tropical birds—seven males and a lone female—were the first of their species ever exhibited alive. The peacocks were magnificent birds, both sexes mantled with green, their heads crested with a spray of delicate feathers.

This past February, almost 19 years after the historic birds arrived at the zoo, the last of them died.

The Congo peacock, only large pheasant found in Africa, was unknown until this century. It was first described in 1936 by Dr. James Chapin of the American Museum of Natural History. Dr. Chapin began searching for this rare animal after seeing one of the bird's feathers being worn by a Central African native. The bird is so unusual that a new genus was chosen for it.

Four of the original Bronx Zoo birds died in 1950. One lived for six more years and the sixth died in 1965. The life span of the last of the zoo's birds is a record for this species in captivity.

Przewalski Horses

Przewalski horses, the only existing species of truly wild horse, have gone on public view at the Bronx Zoo for the first time in almost two decades.

Three of the shaggy Mongolian horses share a large yard adjoining the Bronx Zoo's zebra house. The animals were obtained from the Catskill (N.Y.) Game Farm, which has established a breeding herd of these rare creatures. Only a handful of zoos have Przewalski horses.

Uncommon even in their native range—a small area along the border of China and Mongolia—Przewalski horses are believed facing extinction. Less than 200 individuals are in captivity, these are well managed and an international stud book has been established to ensure that the Przewalski blood lines are kept pure.

The Przewalski horse is closely related to the ancestor of the domestic horse and therefore can interbreed with it.

With a pronounced roman nose and stiff black mane, the Przewalski horse resembles to a great degree the likenesses of Pleistocene horses painted on the walls of European caves by hunters of the late stone age.

Heron Refuge Protected

The sale of 9.9 acres of submerged land within Florida's Great White Heron Refuge has been denied by the trustees of the International Improvement Fund.

The purchase was proposed by Seafarms, Inc., who intended to use the land for shrimp farming. Conservation authorities had expressed opposition to the sale of the tract, located at Tarpon Belly Key.

The mud flats involved in the proposed purchase are an important water bird habitat and, conservationists asserted, sale of the land and the canals to be dug in the submerged area would not be consistent with proper use of the refuge.

THE bookshelf

ANIMAL ECOLOGY IN TROPICAL AFRICA. By D. F. Owen. 122 pp., photographs, text figures. W. H. Freeman and Co., San Francisco, 1966. $5.00.

This book consists of a series of short discussions on animal ecology in tropical Africa. Many topics are touched upon, but none are discussed in detail.

The first chapter contrasts many species of animals that occur in Africa with those that occur in other parts of the world. To this extent it is more zoogeography than ecology, except that no paleontological or evolutionary evidence is given to account for the observed distributions. The next two chapters deal with species diversity and animal populations. After an opening statement that the presence of a large number of species is a characteristic of the tropics of the world, the numbers of various African species are compared with the numbers of species in Europe. No discussion is devoted to the many ecological factors which might account for the numbers of tropical species. Simple observations are made on ecological factors controlling distributions of a few snails, ungulates, and birds. The chapter on periodic events (e.g., seasons, daily rhythms) discusses little that is new (e.g., the greatest seasonal change in animal populations correlates with the rainy or dry seasons; drought can result in migrations of animals; population irruptions occur in the desert locust; some animals aestivate during the dry seasons; and some animals show lunar rhythms). The chapter on ecological genetics doesn't discuss genetics. The chapter on the ecology of man touches lightly on the problems of protein-deficient diets in man, disease, and man's impact on other species.

As a whole the book is extremely superficial in its treatment. It has little to offer either a student of ecology or an interested layman, and the $5.00 price doesn't seem justified.

F. Wayne King

A DEAD WHALE OR A STOVE BOAT. By Robert Cushman Murphy. 177 pp. Houghton Mifflin Company, Boston, 1967. $8.50.

Gloriously worked scrimshaws, the echoing cry of the lookout high above the pitching deck, the taste of salt spray, and the awesome fury of the sperm whale—these and more assault the senses of the reader of Dr. Robert Cushman Murphy's account of a whaling voyage a half-century ago.

With text and photographs, Dr. Murphy unfolds the story of this voyage under sail, made before whaling's romance succumbed to mechanization. A world famous naturalist, Dr. Murphy was an assistant navigator on that voyage in 1912-1913. His book draws back the curtain of years and re-creates the story of man against leviathan as it never will be again. It's a must for those who relish the touch of sea spray and the wash of waves against a sturdy hull.

E. R.

SONG BIRDS OF THE WORLD. By Oliver L. Austin Jr. Illustrated by Arthur Singer. Edited by Herbert S. Zim. 318 pp. $2.95. WATER & MARSH BIRDS OF THE WORLD. By Oliver L. Austin Jr. Illustrated by Arthur Singer. Edited by Herbert S. Zim. 223pp. $2.45. Golden Press, Inc., New York, 1967.

The author of this pair of useful paperback books is curator of birds at the Florida State Museum. He brings knowledge gained from field work around the world into play in describing the birds covered in both books. The illustrator, whose color drawings of more than 500 species in both books is colorful and moving, has won an award from Cooper Union Art School for his work. Dr. Zim, the editor, is a noted science educator and author.

These two books are not new. They are appropriate sections of Austin's 1961 book *Birds of the World.*

E. R.

THE LAROUSSE ENCYCLOPEDIA OF ANIMAL LIFE. Foreword by Robert Cushman Murphy. 640 pp., 1,000 photographs. McGraw-Hill Book Company, New York, 1967. $22.50.

This is a lush, spectacular book of genuine value to the layman. It surveys the animal kingdom, ranging from protozoans to mammals. Because of its scope, it could well be considered superficial by the professional zoologist, but for the armchair variety, this book is a magnificent source of handy, useful facts. The photographs are among the best; the text is readable, clear, and exciting.

This substantial book is based in part on *La Vie des Animaux,* written by the late Professor Leon Bertin. It is divided into 24 sections, each of which represents a key zoological group. This new Larousse encyclopedia is a costly but worthwhile addition to anyone's bookshelf.

E. R.

BIRDS OF AMERICA. First complete reprinting of Audubon's *Birds of America* since 1871. By John James Audubon. Seven volumes, paperback, 500 plates in black-and-white. Dover Publications, Inc., New York, 1967. $2.50 per volume.

Audubon's great work is here introduced by Dean Amadon, Lamont Curator of Birds, American Museum of Natural History. The plates have been interspersed with the text, and two new indices to changes in nomenclature have been prepared by the American Museum's John Bull. The volumes are bound in paperback, but are so sturdily constructed that they will last, even with frequent use.

E. R.

SO EXCELLENT A FISHE. By Archie Carr. 248 pp., 3 maps, 45 plates. Natural History Press, Garden City, New York, 1967. $5.95.

So Excellent A Fishe is a natural history of sea turtles, which, of course, aren't fish at all. But such a title is to be expected of Archie Carr, who not only knows more about turtles than anyone else but is also a superb and puckish writer. Sitting down with a book of Dr. Carr's is like addressing oneself to a delicious meal and a conversation with a brilliant and compelling dinner companion. Carr doesn't write about sea turtles, he talks about them, and he talks as though he were right there in the room foreseeing and forestalling whatever objections his discourse might have brought to his dinner companion's mind.

Sea turtles are creatures of mystery; even the nesting grounds of some forms are still unknown. The Atlantic ridley, until recently, was among these mysterious nesters and the story of the discovery of its nesting grounds is as fascinating as the tale of its diminution is dismal. The movements and migrations of sea turtles are not at all well understood but Dr. Carr has made it his business not only to find out as much as he can about where turtles go and what they do, but also why they do it. His book follows his own travels around much of the world looking for turtles but concentrates upon the Caribbean. Throughout the narrative runs the thread of the problem of sea turtle conservation and the sociological flavor of man-turtle relationships. Especially rewarding chapters concern the trials and tribulations of the would-be turtle tagger and a remarkable aggregation of letters from individuals around the Caribbean who have caught turtles with tags and written Carr of their experience. Zoological Society members will enjoy reading of the aid and work of trustee John H. Phipps and former director James A. Oliver.

So Excellent A Fishe is a more technical work (with a good index) than *The Windward Road* or *Ulendo* but no natural history buff or turtle soup gourmet will be able to skip a word.

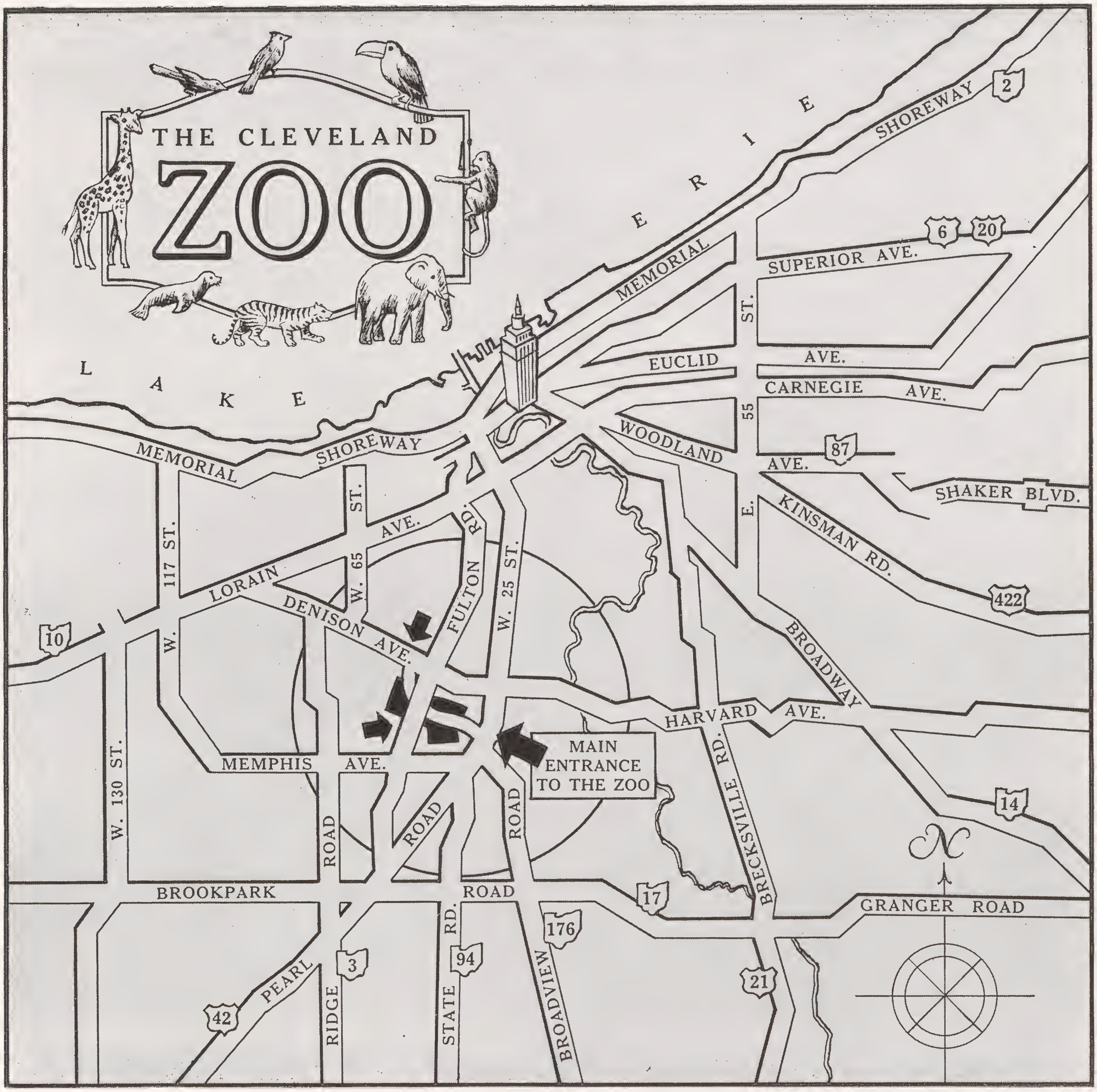
William G. Conway

ABOUT THE authors

William J. Cromie is an author who writes often on the sea. **Jack and Inger Bradbury** are biologists at the Institute for Research in Animal Behavior. **John Hillaby's** articles appear regularly in the *New Scientist.* **Stan Federman,** a West Coast journalist, has written several articles on primates. **William M. Partington** is assistant director of the Florida Audubon Society.

ILLUSTRATION CREDITS

Cover—Gordon Smith, National Audubon Society; pp. 4-5—Marineland of Florida; pp. 6-8, 11—William J. Cromie; pp. 12-13, 15—Inger Bradbury; pp. 16-17—Jack Bradbury; pp. 18-19—Inger Bradbury; p. 20—NYZS; pp. 22, 25-27—David Falconer; p. 28—NYZS; p. 30—Woodland Park Zoo; pp. 31-32—NYZS.



VISITING CLEVELAND, OHIO?

The Cleveland Zoo is operated by the Cleveland Zoological Society. Founded in 1882, the zoo on its present site covers 110 acres and has 1,200 animals on exhibit.

This is one in a series of travel guides to zoos and aquariums presented by ANIMAL KINGDOM as a service to its readers. We welcome submission of maps and information to be used on this page.

NEW YORK ZOOLOGICAL SOCIETY

90.673
59

animal kingdom

VOL. LXXIII, NO. 3, JUNE, 1968

SMITHSONIAN
AUG 23 1968
LIBRARIES

NEW YORK ZOOLOGICAL SOCIETY
630 Fifth Avenue, New York, N. Y. 10020

President
Fairfield Osborn

First Vice-President
Laurance S. Rockefeller

Vice-President
Henry Clay Frick, II
Robert G. Goelet

Secretary
Howard Phipps, Jr.

Treasurer
David Hunter McAlpin

Assistant Treasurer
Eben W. Pyne

Assistant Secretary
Harold C. Palmer

BOARD OF TRUSTEES
(Executive Committee)*
Alexander Aldrich, George F. Baker, Jr.*, Robert E. Blum, William R. Coe, C. Suydam Cutting, John Elliott, Charles W. Engelhard, Henry Clay Frick, II*, Robert I. Gannon, Peter R. Gimbel*, Robert G. Goelet*, Peter Grimm, John N. Irwin, II*, Warren Kinney, Anthony D. Marshall, Otto Marx, Jr., David Hunter McAlpin*, Peter Matthiessen, G. W. Merck, Charles W. Nichols, Jr.*, Fairfield Osborn*, Augustus G. Paine, II, Howard Phipps, Jr.*, John H. Phipps, John Pierrepont*, Eben W. Pyne, Laurance S. Rockefeller*, David T. Schiff, John M. Schiff, Henry Sears, Chauncey Stillman, Joseph A. Thomas, Landon K. Thorne, Jr., Alfred G. Vanderbilt, Robert Winthrop.

Ex-Officio:
The Mayor of the City of New York
Hon. John V. Lindsay

Administrator of Recreation and Cultural Affairs
August Heckscher.

General Director
William G. Conway

ZOOLOGICAL PARK
William G. Conway, *Director & Curator of Birds;* Charles P. Gandal, *Veterinarian;* Hugh B. House, *Associate Curator & Chairman, Mammals;* Grace Davall, *Assistant Curator, Mammals & Birds;* David W. Nellis, *Mammalogist;* James G. Doherty, *Mammalogist;* Joseph Bell, *Associate Curator, Birds;* Donald F. Bruning, *Ornithologist;* F. Wayne King, *Associate Curator, Reptiles;* Herbert J. Knobloch, *Curator, Education;* Charles B. Driscoll, *Superintendent, Operations;* Edward Kearney, *Manager, Facilities Dept.;* Joseph A. Davis, Jr., *Scientific Assistant to the Director;* Lee S. Crandall, *Zoological Park Consultant & General Curator Emeritus;* William Bridges, *Curator of Publications Emeritus;* Roland Lindemann, *Consultant, Mammal Management;* John M. Budinger, *Consultant, Pathology.*

AQUARIUM
Ross F. Nigrelli, *Director;* Nixon Griffis, *Administrative Assistant to the Director;* Robert A. Morris, *Curator;* Lars Mellkvist, *Superintendent;* Jewell Bungay, *Business Manager;* Louis Mowbray, *Research Associate, Field Biology;* Christopher W. Coates, *Director Emeritus.*

OSBORN LABORATORIES OF MARINE SCIENCES
Ross F. Nigrelli, *Director;* Martin F. Stempien, Jr., *Assistant to the Director;* George D. Ruggieri, S.J., *Coordinator of Research;* William Antopol, C. M. Breder, Jr., Jack T. Cecil, Harry A. Charipper, Kenneth Gold, Myron Jacobs, Klaus Kallman, Vincent Liguori, John J. A. McLaughlin, Martin P. Schreibman, Eva K. Hawkins.

INSTITUTE FOR RESEARCH IN ANIMAL BEHAVIOR
(Operated jointly by the Society & Rockefeller University)
Donald R. Griffin, *Director;* Peter R. Marler, Jocelyn Crane, Roger S. Payne, Richard L. Penney, Fernando Nottebohm, George Schaller, Thomas T. Struhsaker, C. Alan Lill.

WILLIAM BEEBE TROPICAL RESEARCH STATION
O. Marcus Buchanan, *Resident Director*

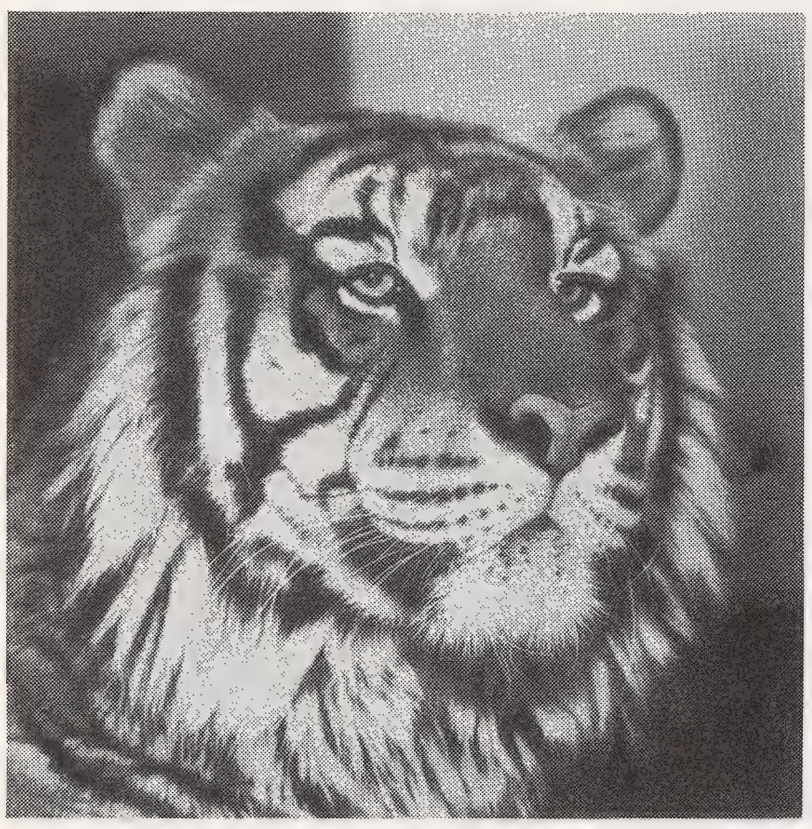
GENERAL
Walter Lerchenfeld, *Comptroller;* Bernard M. Fagan, *Accounting Manager;* John McKew, *Personnel Manager & Assistant to the Director, Zoological Park;* Gordon Cuyler, *Membership Chairman & Administrative Associate;* Jerry M. Johnson, *Curator, Department of Exhibition and Graphic Arts;* Edward R. Ricciuti, *Editor & Associate Curator, Publications and Public Relations;* Elysbeth H. Wyckoff, *Production Editor;* Dorothy Reville, *Photo Librarian;* Sam Dunton, *Photographer.*

AFFILIATE
Jackson Hole Biological Research Station
L. Floyd Clarke, *Director.*

ANIMAL KINGDOM STAFF
Edward R. Ricciuti Editor and Associate Curator, Publications and Public Relations
Elysbeth H. Wyckoff Production Editor
Jerry M. Johnson Curator of Exhibition and Graphic Arts
Dorothy Reville Photo Librarian
Sam Dunton Photographer
William Meng Photographer

animal kingdom

MAGAZINE OF THE NEW YORK ZOOLOGICAL SOCIETY VOL. LXXIII NO. 3 JUNE, 1968



ABOUT THE COVER

The passenger pigeon belongs to legend. So does the dodo. The quagga no longer grazes on the veldt. And the roaring of the magnificent Cape lion has been stilled for a hundred years. These and legion other wild creatures have vanished from this planet in the last four centuries or so — victims, in one way or another, of homo sapiens. In this issue, the general director of the New York Zoological Society, William G. Conway, examines the drains that man and his activities continue to place on wildlife. He points out some startling statistics — facts so important that this issue was held up so that they could be researched.

CONTENTS

THE COTINGAS A Study in Contrasts 4
by Alexander F. Skutch

NECTAR FEEDING BATS 10
Photographs by Dominic Crolla

ADVENTURES AND MISADVENTURES OF THE GREEN TURTLE
Part II—Adventures 13
by William J. Cromie

THE CONSUMPTION OF WILDLIFE BY MAN 18
by William G. Conway

EXPEDITION SEA OTTER 24
by C. Jack Barton

THE DANCE OF THE BEES 28
by Edward Edelson

ANIMAL KINGDOM REPORTS 33

ABOUT THE AUTHORS 34

ILLUSTRATION CREDITS 34

Issued bi-monthly by the New York Zoological Society at the Zoological Park, Bronx, N. Y. 10460. Editorial and Subscription Offices at the same address. Title registered with the U. S. Patent Office. Subscription, $3.50 a year; single copy, 60 cents. Same rates for all foreign countries and Canada. Second-class postage paid at Bronx, N. Y. Send Form 3579 to Bronx, N. Y. 10460.

©1968 New York Zoological Society. All rights reserved.

THE COTINGAS

A STUDY IN CONTRASTS

By Alexander F. Skutch

THE BIRDS of tropical America have lacked publicity. Nearly everyone with a smattering of natural history or a more than local interest in birds has heard of the birds of paradise, those profusely ornate inhabitants of New Guinea and neighboring islands. But how many have heard of the cotingas, a family twice as large and certainly no less remarkable?

The 90 species of cotingas are confined for the most part to the wooded regions of continental tropical America, from northern Argentina to Mexico. One species, the Jamaican becard, is endemic to that island, and one, the rose-throated becard, reaches the extreme south of the United States, from Texas to Arizona. This family of passerine birds, related to the American flycatchers and the manakins, has an unusual range in size, with some members reaching crow size and others among the most diminutive of birds.

Although the coloration of the cotingas is exceedingly diverse, these birds are less lavishly ornamented than the birds of paradise. Frills and flounces would only detract from the chaste loveliness of the snowy cotingas *(Carpodectes)* or the restrained beauty of the glossy blue cotingas *(Cotinga).*

Other species display brilliant red, orange, yellow, glittering green, rich purple, or bright rufous-cinnamon, while some are clad in modest gray or somber black. In addition to colorful plumage, many cotingas have areas of bare skin, red, scarlet, or bright blue, on the cheeks or covering much of the head and neck. Special adornments are exceptional in the cotinga family. The ornamentation of certain cotingas, however, verges on the fantastic, as in the big, black umbrella birds *(Cephalopterus),* with their helmetlike crest of feathers extending over their bills and a long, fleshy appendage pendent from their forenecks. (Long-wattled umbrella bird appears on opposite page.)

To this family belong the four species of bellbirds *(Procnias),* famed for their ringing calls. The white bellbird of the Guianas and Amazonia, which has a single fleshy wattle hanging stringlike from its forehead, utters a *kong kang* that sounds like a hammer blow on an anvil and a resounding kaaaaaaaaaang said to be audible at a distance of three miles.

The three-wattled bellbird of the highlands of southern Central America is a stout bird a foot long, clad in a rich shade of brown, with pure white head and neck. From the base of its bill hang three long, flexible wattles, which are not, as sometimes depicted, erectile. This bird's loud calls, uttered with its mouth gaping to reveal a black interior, have a wooden rather than a metallic quality. The females of the bellbirds, as of most of the more striking cotingas, are clad in duller shades and have no wattles.

Cotingas spend much of their lives in treetops, where they are difficult to see, and in woodland often teeming with mosquitoes and other pests and by no means free from venomous snakes. A foretaste of what is in store for the diligent observer of cotingas is provided by Barbara Snow's recent study of the calfbird or capuchin bird *(Perissocephalus tricolor)* in Guayana. This big cotinga, about 13 inches long, is chiefly chestnut brown, with black tail and wing feathers and bright orange undertail coverts. The bare skin of the face is bluish gray. The sexes are alike. These birds display communally in trees that are nearly leafless; they perch on branches, from which they snap off twigs to increase visibility. In the most striking of these performances, two calfbirds perch side by side, facing the same way and leaning forward, with their tails cocked up and their orange-brown undertail coverts conspicuously puffed out. Gradually elevating their bodies in unison, they utter a growling *grrr,* which changes to *aaa* and finally, when they have

SMITHSONIAN INSTITUTION AUG 2 1966

passed the vertical posture and are leaning slightly backward, to the far-carrying *moo,* like the lowing of a calf, for which they are named. The meaning of this unique display has not been clarified.

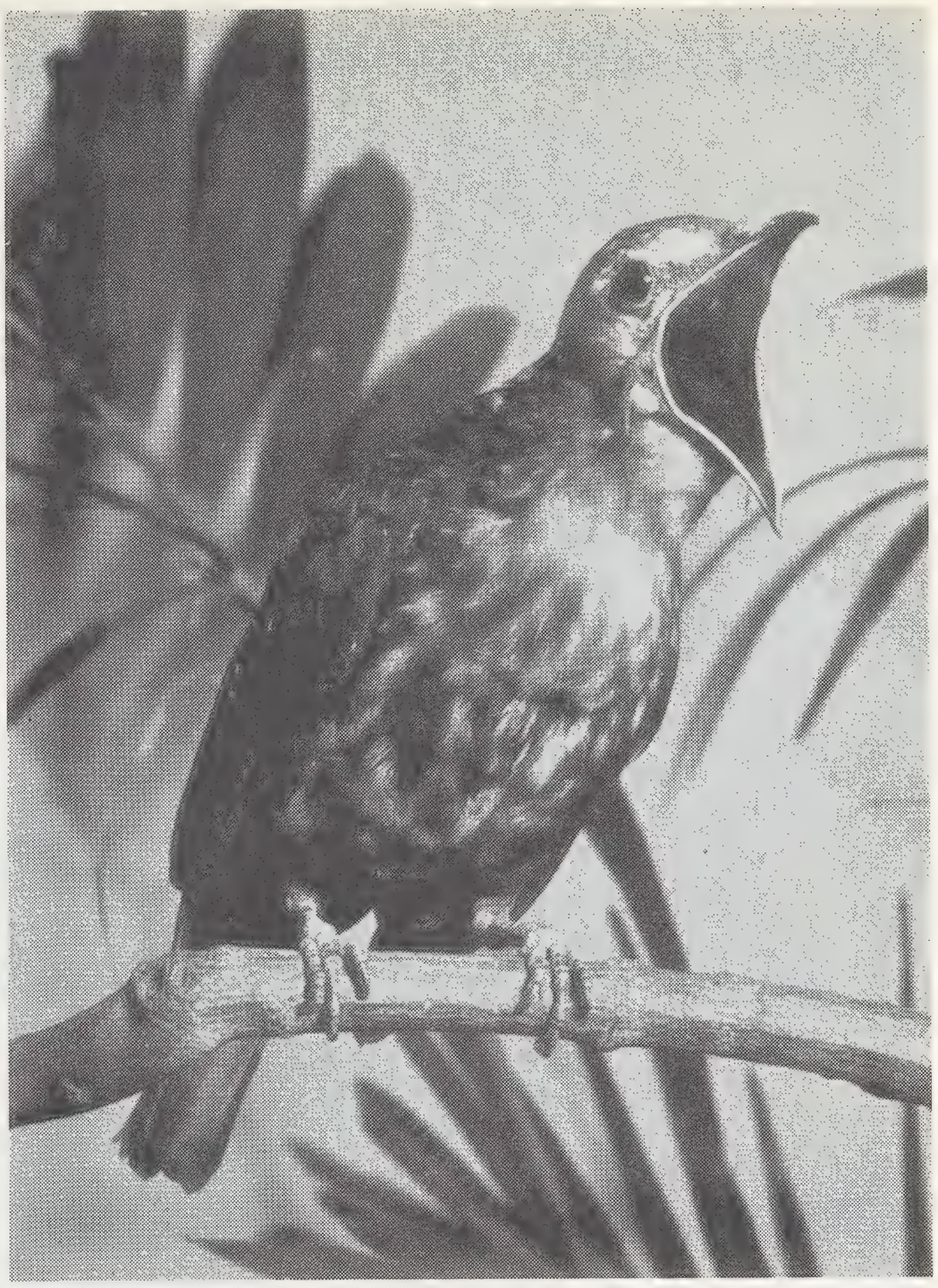
Cotingas subsist on a mixed diet including fruits, insects, and spiders. They perch well up in trees, turning their heads from side to side until their keen eyes detect a suitable food item, often a green insect inconspicuous against a green leaf. Then they dart out, snatch the insect from the foliage without alighting, and carry it to a perch.

Some cotingas concentrate on larger prey. A pair of bright-rumped attilas that I recently watched nourished their nestlings chiefly with small lizards and frogs.

The nesting habits of cotingas are as diverse as their appearance and voices. Their nests range from the slightest structures to some of the bulkiest built by birds of their size. Other cotingas breed in holes in trees. Nesting females of certain species are quite solitary, whereas in others males attend their nesting mates. In no cotinga, as in no flycatcher, is the male known to incubate or brood, but he may help to build the nest and do his full share in feeding the young.

Perhaps I can best convey the diversity of habits in the family by telling about three species resident on our farm in the valley of El General in southern Costa Rica.

Of these three cotingas, the masked tityra *(Tityra semifasciata),* which ranges from Mexico to Bolivia and Brazil, is the most conspicuous and familiar. As the male of one of these stout, eight-inch birds flies overhead, he appears to be almost wholly white. Closer scrutiny through binoculars, after he has come to rest on some high perch, reveals that his upper plumage is mostly pale bluish gray. The wings are largely black; the pale gray tail is crossed by a broad black band; and his bare cheeks are bright red, framed in black feathers. The female is browner above and grayer below, and the naked skin around her eyes is paler red. In pairs or small flocks, tityras roam widely through the treetops, not only in the forest but also in plantations and pastures with scattered



Native to the southern highlands of Central America, the three-wattled bellbird has a resounding call.

trees. Their curious low grunts and dry, insect-like notes contrast with the stentorian proclamations of certain other cotingas.

In the dry season, pairs of tityras frequent the forest borders and new clearings where early-nesting woodpeckers are carving their holes or are already rearing their brood. The tityras prospect for the cavity they need for their eggs. They annoy the woodpeckers by filling their holes, in which incubation has not yet started, with leaves and other litter.

Sometimes, tiring of throwing out the steadily accumulating trash, the woodpeckers relinquish their newly made cavity to the tityras and begin another for their own eggs.

Tityras may even dispossess a flock of the much larger araçari toucans from the cavity where the big birds sleep by filling the hole with leaves and twigs until the toucans no longer fit into it. As far as I have seen, tityras always gain possession of a nest hole by indomitable persistence rather than by violence. The female brings practically all the nest material

Her mate makes a great show of carrying leaves and twiglets but carelessly drops most of them outside.

In regions with tall trees, tityra nests are commonly found from 40 to 100 feet up, usually in decaying trunks whose questionable stability makes a prudent man hesitate before an ascent.

I shall never forget my first visit to a tityra's nest. Years ago, when the coves and backwaters of Gatún Lake in the Panama Canal Zone were studded with the gaunt skeletons of forest trees that had been drowned by the rising waters of the impounded Río Chagres, I saw a tityra enter a hole 35 feet up in a massive rotting trunk about 100 yards from the shore. I should never have dared to climb such a trunk on dry land, but I decided to risk a fall into the water in order to examine the eggs, since I had never seen these described.

From a cayuco, we threw a cord over the top of the broken-off trunk, then drew a rope over, and pulled up a rope ladder. My determination to climb the trunk dissolved as great chunks of rotten wood, dislodged by the rope, splashed into the water around us; but my helpers urged me on. On the way up, I passed a large cavity containing two naked nestlings of the blue-headed parrot. At the very top of the trunk was an irregular hollow, descending obliquely into a short decaying stub. When I peered in, nothing was visible except a loose litter of leaves, but beneath them my fingers encountered two eggs. They had a most peculiar aspect, dark buff or *café au lait*, heavily marbled with brown, especially on the thicker end, and spotted here and there with black. They were typical cotingas' eggs.

Many years passed before I found a tityra's nest that could be reached with only moderate risk. This nest was only 11 feet up, in a hole carved by red-crowned woodpeckers in a slender, badly decayed trunk that stood in a cornfield, near the forest. By propping the trunk at the back and setting a ladder nearly upright against the front, I could reach the hole without toppling the trunk. Since the opening was too narrow to admit my hand, I illuminated the interior of the nest with an electric bulb and looked in with the aid of a mirror.

During the three weeks that the female incubated in this nest, I made numerous visits of inspection without once glimpsing an egg. Whether she departed spontaneously or fled as I approached, she always left the eggs completely buried in the loose litter for their better protection.

Then came a day when my light and mirror revealed half of an empty shell lying upon the leaves. I heard peeping and from time to time saw the leaves move but I could not see a nestling. On the following morning, however, I glimpsed parts of two nestlings before they disappeared beneath the leaves. The few tufts of gray down on their heads, backs, and wings failed to conceal their pink skin. Their eyes were tightly closed. On my inspections during the following days, I sometimes saw the leaves move and heard a little weak peeping; but most of the time the nestlings lay so still beneath the leaves that only continued parental attendance at the nest convinced me that the young remained.

After their tenth day, the young tityras were sometimes found with their heads exposed but their bodies covered. From their fifteenth day onward, however, they rested on rather than beneath the litter, their bodies wholly exposed. Their plumage developed slowly, and they were not well feathered until they were three weeks old. When they were 24 days old, their mother tried persistently but without success to call them from the hole. One remained in the nest a full four weeks, the other a day or two longer. When finally they emerged, their plumage resembled that of the adult female.

Throughout the long nestling period, both parents brought food, the mother somewhat more often than the father. At first the nestlings were given only insects, which became larger as the days passed. Soon fruits were added to the diet, especially the green, olivelike fruits of a tree of the laurel family, each with a single large seed that the nestlings regurgitated. Occasionally there was a spider, a tiny land snail, or even a small lizard. The parents also continued to bring leaves to the nest and seemed stimulated to do so by any exciting event, such as hatching, my visits to the nest,

or the imminence of a fledgling's departure.

The first two articles that the female took to the nest after the eggs hatched were leaves rather than food; just before the first nestling flew, its mother, clinging outside the doorway, dropped a billful of leaves before its open mouth.

A less conspicuous neighbor of the masked tityra, over much of its wide range, is the white-winged becard *(Pachyramphus polychopterus)*, a bird hardly bigger than a wood warbler, but with a stouter body and larger head. The male's upper plumage is mostly blackish, with gray on the rump and conspicuous white marks on the wings and shoulders. Below, he is dark gray, paler on the abdomen. The female is prettily attired in delicately blended shades of greenish olive, pale yellow, cinnamon, and buff. These cotingas are most often seen, singly or in pairs, along the forest edges and in the crowns of trees scattered through pastures and other clearings. In contrast to many other cotingas, their voices are soft and melodious. At daybreak in the nesting season, the male repeats over and over, hundreds of times with hardly a pause, an arrestingly beautiful song consisting of about eight dulcet notes.

The female builds the bulky nest, which is usually far out on a thin branch high in a tree standing apart from other trees. The male, who does no work, often perches close by the nest that his mate is making, from time to time singing sweetly or driving away intruding birds with a loud clacking of his short, thick bill. Of the many becard nests that I have seen, only two were accessible to me. These were roughly globular constructions, about seven inches in diameter. A round doorway in the side, one and a half inches in diameter, gave access to a chamber about three inches wide and high. These nests were composed chiefly of long skeins of more or less shredded bast fibers, with dry leaves and grasses lining the chamber all around. One nest contained four eggs and the other three, which appears to be the more usual number. In coloration they resembled the tityra's eggs, but they were much smaller.

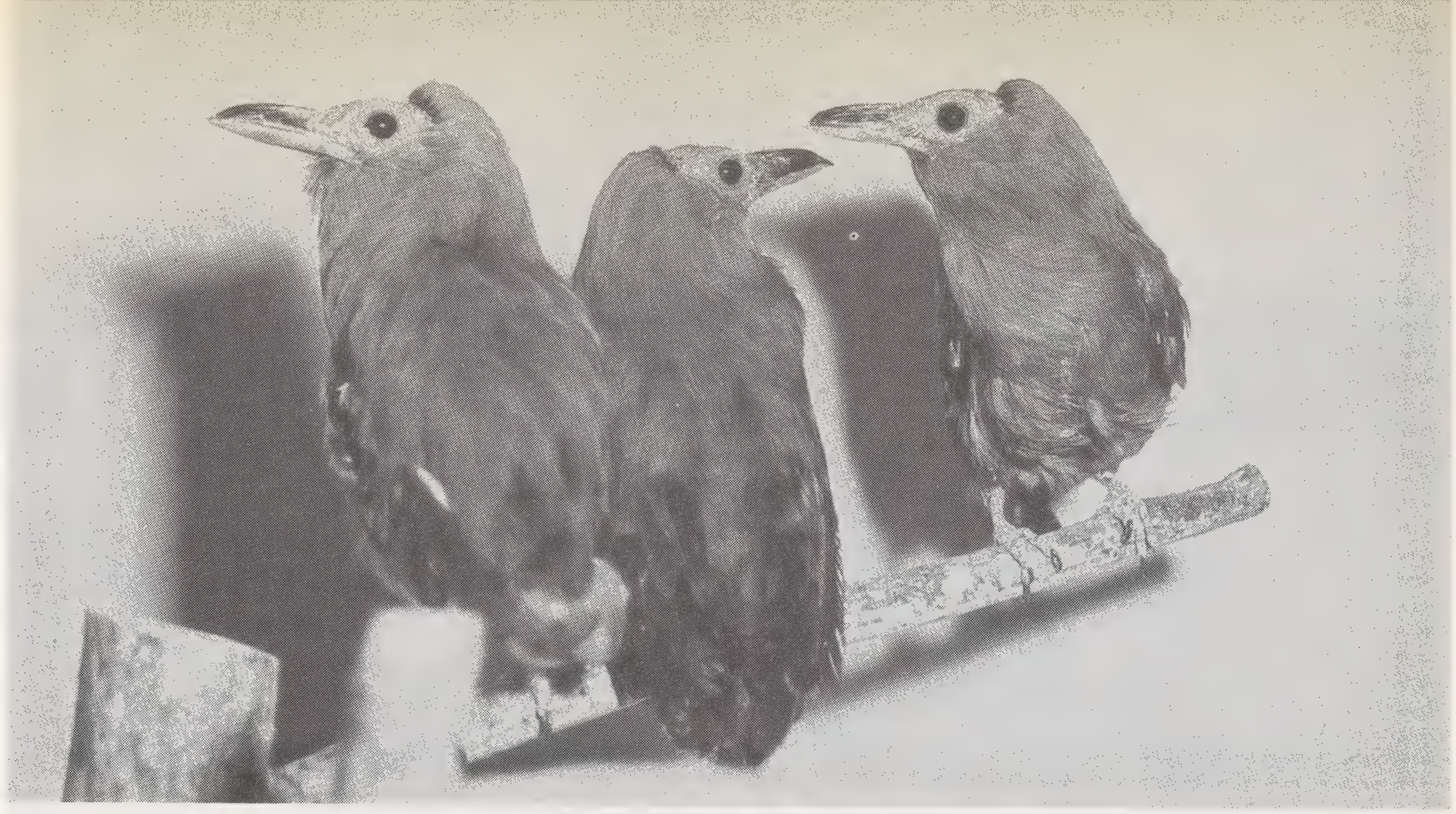
Only the female becard incubates, and she sits very inconstantly, apparently depending on the thick walls of her nest to keep her eggs warm while she is absent. In 10 hours of watching, one female never remained in her nest longer than 38 minutes at a stretch. Her average session was only 15 minutes, and she was in the nest only 45 per cent of the day. She continued to add much material to her nest until her eggs hatched, after 18 days of incubation.

The tiny, blind, pink-skinned nestlings lacked the sparse down typical of newly hatched passerines. As far as I saw, the nestlings received only winged insects and larvae from both parents. When, at the age of 16 days, the young becards were well feathered, they gave fair imitations of the male's day song, sometimes answering when their father sang in the distance. Their soft notes, filtering through the nest's thick walls, sounded much weaker than those of the parents. At the age of three weeks, the young left the nest, wearing a plumage much like that of their mother.

Now, as they roamed with their parents through the treetops about our house, they revealed their presence by the little songs and soft notes that they constantly repeated, but they were most difficult to glimpse amid the clustered foliage.

Unlike the tityra and the becard, the rufous piha *(Lipaugus unirufus)* rarely ventures beyond the forest, where it stays well up in the tall trees, betraying its presence by its sudden, sharp, powerful whistles. Any loud sound, such as the snapping of a dry branch underfoot, a shout, a sneeze, a handclap, a peal of thunder, may be answered by the piha's whistle; but usually one must look long before he spies the bird. The male and female of this robin-sized bird are clad exactly alike, with bright rufous feathers and both can whistle loudly, although apparently the male does so more persistently. The whistle is often a disyllable that suggests the bird's name. Sometimes it is prolonged into a musical trill.

I had found many nests of the tityra and the becard before I discovered one of the piha. One day, while walking along a woodland path, I noticed a female piha resting on a slender branch about 20 feet up in a small tree, in an attitude that excited my curiosity. When, after



Both sexes of the capuchin bird look alike. This bird is chestnut-brown, with black tail and wing feathers, and brilliant orange undertail coverts.

sitting motionless for a long while, the bird flew off, she left exposed a nest so diminutive that it had been largely hidden beneath her. It was a nearly flat pad about three inches in diameter, composed almost wholly of coiled tendrils, and supported by two horizontal twigs no thicker than a lead pencil. Looking up through the meshes of this incredibly slight structure, I could see that it held—most precariously, it seemed—a single egg that was smoky gray, heavily mottled with dark brown.

Of the four pihas' nests that I found later, three were similarly situated on several slender twigs and one rested on a single stouter branch. All were in the lower story of tall woodland, from 17 to 35 feet up, where they were sheltered from the wind that often sways the crowns of the taller trees and would roll the egg from so shallow a nest. These nests had been reduced to the absolute minimum compatible with their function of supporting egg and nestling.

Many hours of watching during building, incubation, and rearing the young failed to disclose that the female was ever helped by a male; indeed, pihas, like bellbirds and blue cotingas, seem not to form pairs.

It was surprising to see a bird as big as the piha, after incubating quietly for an hour or two, spread her wings and fly right up from her egg, just as a hummingbird does. One egg took 25 days to hatch, which is twice as long as the incubation period of thrushes and finches of about the same size. I am aware of no other passerine, except the far bigger superb lyrebird of Australia, whose eggs take so long to hatch. Probably the poor insulation afforded by the thin, open meshwork on which the egg lies contributes to the length of the incubation period.

Nourished by its mother with insects, spiders, fruits, and an occasional small scorpion, the nestling piha develops slowly. Still largely naked at the age of 11 days, it is feathered at 17 days. Nevertheless, the parent continues to brood it. At night, and in the rain, it was brooded until at least 27 days old. When, at the age of 28 or 29 days, it finally left the nest, it resembled the adults in coloration but had a stubby tail.

From the beginning of nest building to the fledgling's departure, the piha takes about 64 days to rear a single offspring. Yet despite its slow rate of reproduction, the piha is the most abundant bird of its size, or larger, in our forest. No less surprising than the leisurely pace of development is the fact that egg and nestling remain for so many weeks on the narrow platform where they seem to lie so precariously. They owe their survival to the habitually slow, deliberate movements of the parent bird and the quietness of the nestling, who, without competing nest mates, always takes its meals in a leisurely, restrained manner.

These are some of the contrasts that the wonderful cotinga family presents. Doubtless others still more surprising await discovery by diligent naturalists.

NECTAR FEEDING BATS

Photographs by Dominic Crolla

ONCE A HAVEN for western badmen, Colossal Cave, a tourist mecca less than 20 miles from downtown Tucson, Arizona, now serves as a maternity colony for thousands of long-nose bats, *Leptonycteris sanborni.*

These flying mammals, which subsist on the nectar of cactus blossoms, have been the subject of extensive study by Dr. E. Lendell Cockrum, a professor and mammalogist at the University of Arizona. Dr. Cockrum's work played a major role in establishing the feeding habits of the bats. Much of his research involved observations of bats feeding upon the cactus within a large tent.

The photographs shown here of long-nose bats tapping cactus flowers for nectar were taken in that tent by Dominic Crolla.

adventures and misadventures of the green turtle

PART II—ADVENTURES

By William J. Cromie

It was the strangest turtle Captain Charlie Bush had ever seen. It lay on its back in the bottom of his boat, hissing, blinking, and slapping its belly shell with long front flippers. In 30 years of fishing, the grizzled Cayman Islander had seen thousands of green turtles but never one with notches or bites spread with odd regularity around the edges of all four flippers. Captain Charlie wondered what kind of ambitious little fish had been nibbling on the reptile. He sucked his pipe into life and thought about it a long while before trussing up the 300-pound male for the trip to Nordberg Thompson's turtle soup factory at Key West.

Eight months later, Captain Charlie was turtling again on Mosquito Bank off Nicaragua. Late one afternoon he set a net on the small coral head where the notch-fin turtle had been captured. Next morning, when his boatmen heaved the loaded net over the side of the dory, Charlie saw the same kind of striking scars on the flippers of the turtle thrashing around in the bottom of his boat.

"Is it him, Cop'm?" one of the boatmen asked.

"It has to be him," Charlie replied. He held one of the slapping fins and traced out a brand on the crusted belly shell. Sure enough, he had cut that brand himself months before.

Churned up by an October hurricane, heavy seas had slammed into Thompson's turtle crawls and washed all the imprisoned animals, including old notch-fins, to their freedom. Somehow the marked turtle managed to find his way back to the one rock in the Caribbean that he called home.

When Captain Charlie told Professor Archie Carr this story, it confirmed what the University of Florida zoologist had suspected for a long time—"that green turtles *(Chelonia mydas)* make long treks across the open sea and are gifted navigators." But trying to convince other scientists that a reptile with a reputation for being sluggish and stupid possesses uncanny powers of navigation was not easy. As Carr says, "It is true that a lot of different kinds of animals have such powers, but adding a turtle to that gifted list is not a thing to do lightly or without impeccable grounds."

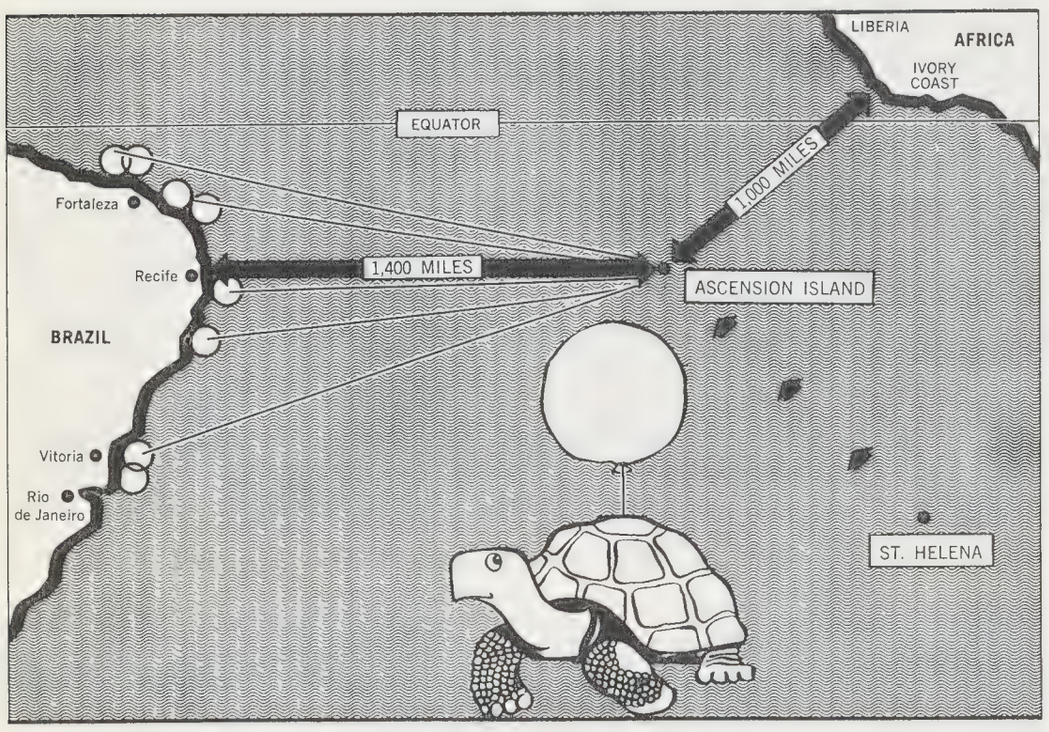
From what turtle captains and island Creoles said, the best place to start was Turtle Bogue, the black beach at Tortuguero, Costa Rica, where greens from all over the western Caribbean go to mate and nest.

For ten consecutive summers, the wiry, 58-year-old zoologist and his students had patrolled this beach and put metal tags on the flippers of more than 4,200 females who had come ashore to lay their eggs. To date, turtle fishermen have returned 175 of the tags, which were taken from turtles feeding up to 1,500 miles away. The metal tags were mailed to Professor Carr from Florida, Cuba, Mexico, Nica-

ragua, Panama, Colombia, and Venezuela.

Turtles tagged at Tortuguero have never been found there after nesting season and have never been found nesting anywhere else. No correlation exists between distance traveled and time elapsed from tagging to recovery.

But does this travel involve anything more than piloting by coastal landmarks? Green turtles could simply leave their home pastures and follow the coast until things smell, taste, or feel in ways that mean their ancestral breeding ground has been reached—ways that have been imprinted in their "memories" since birth.



Green turtles cross 1,400 miles of ocean to land on a seven-mile-wide island in mid-Atlantic. The turtles voyaging from Brazil to Ascension Island must battle a current of two-three knots and swim without rest for two months before landfall on the tiny tropical island.

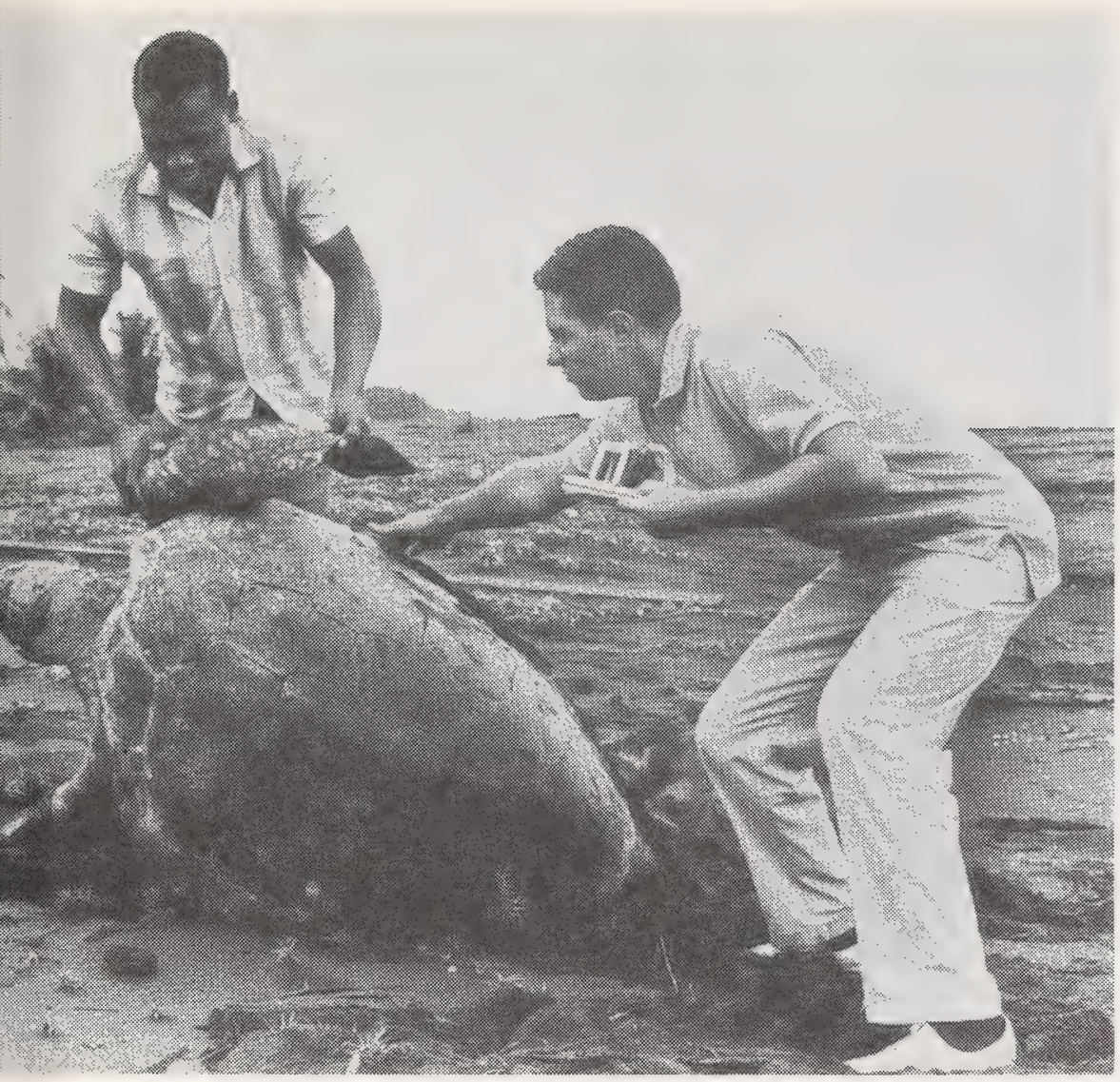
In searching for an instance of turtle travel that clearly involves an ability to make long, oriented sea journeys in the absence of landmarks, Professor Carr thought of the colony of greens that nests on Ascension Island. Every February large numbers of turtles begin to arrive at this remote spire of rock lost in the vastness of the South Atlantic. No lush pastures of turtle or eel grass exist around lonely Ascension, so by June all the males and females have gone somewhere else to feed. But where? The African mainland is a thousand miles away and 1,400 miles of open ocean separate Ascension from the Brazilian coast.

Although longer, the route to Brazil would be easier for both the spent adults and the young hatchlings. The south equatorial current flows westward from the African coast to the shores of South America, and a tired adult or weak baby turtle could get a welcome push. Such journeys would conform to the classical migration pattern of aquatic animals. The strong, capable adults swim upstream or against the currents to reach their spawning grounds, then the weak, inexperienced young ride the currents downstream.

In 1957, Professor Carr searched the coasts of Brazil and Argentina. He found plenty of seaweed and green turtles, but no nesting sites. To see if turtles that feed off Brazil swim all the way to Ascension to nest, Professor Carr sent graduate student Harold Hirth, now professor of zoology at the University of Utah, to the remote volcanic island in 1960. From February to April, Hirth tagged 206 females at six nesting beaches. Since that time nine of these tagged turtles have been found off the Brazilian coast by fishermen. In 1963, when the group that nests every three years was due back at Ascension, a tag patrol came across three of Hirth's turtles. In 1964, when the two-year nesting group was due to return a second time, two more tagged animals were discovered. Four of these five females landed on the same short section of beach where Hirth first labeled them. The fifth came ashore on a recently formed beach next to her old nesting site.

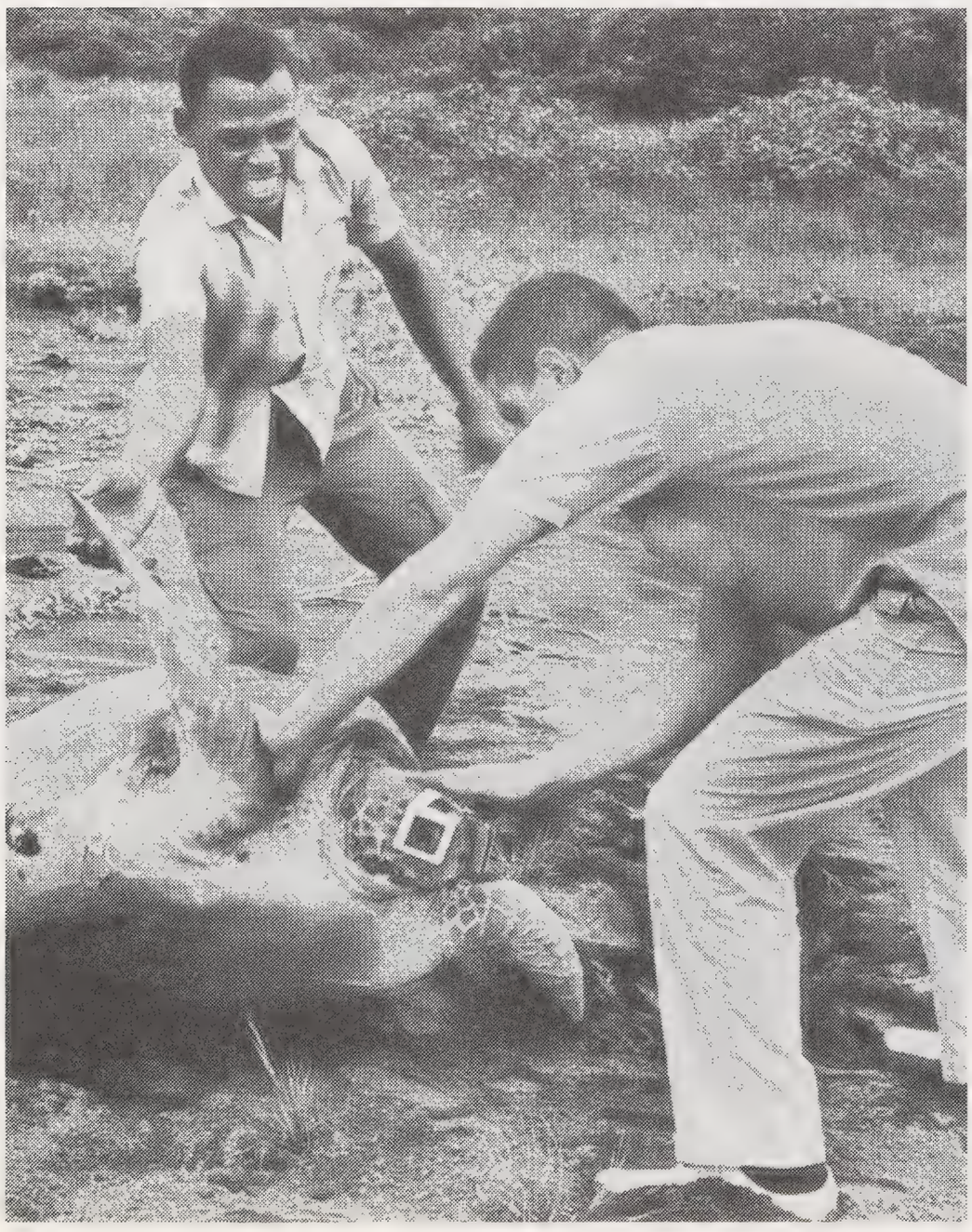
Archie Carr says, "This does not prove beyond all possible doubt that turtles regularly cross the open ocean between Brazil and Ascension, but I think it does so beyond all reasonable doubt."

For these reptiles, it's "uphill" all the way. They may have to buck a 2-3-knot current and swim steadily for two months to reach their destination—all the while without food and landmarks, only the trackless waves and two miles of dim water under their bellies. Despite the vagaries of winds and currents, the tooth-filled jaws of sharks, and the playful pushes of porpoises, the turtles must hold their course and keep their orientation. "The difficulties facing such voyages would seem insurmountable," says Professor Carr, "were it not so clear that the turtles are somehow surmounting them."



With a hand from Glenn Martinez, Dr. Ehrenfeld prepares to fit turtles with glasses.

Glasses determine part of vision in the ability of female turtle to go from nest to sea.



How do they do it?

From the day of their birth green turtles exhibit an amazing ability to find their way. Mother turtles bury about 100 eggs in a two-foot-deep nest laboriously dug in the sand of the nesting beach. When the newborn thrash their way to the surface, some two months later, the paddle-footed babies set a straight course for the sea, even though they have never seen water and it may be out of sight behind dunes or brush. When the silver-dollar-sized babies are born in a hatchery, they crowd against the part of the fence nearest the sea.

Archie Carr flew hatchlings from the Caribbean coast across Costa Rica and let them emerge from artificial nests fronting the Pacific. these turtles reached it as easily as their nest mates on the home beach at Tortuguero. Carr concluded from this that no direction sense was involved.

To learn more about this sea-finding mechanism, I helped University of Florida zoologist Dr. David Ehrenfeld wrestle eyeglasses onto 200-400-pound turtles at Tortuguero. To reach the water these mature females must rely on the same clues they used as hatchlings. (Many of them deposit their eggs in vegetation or behind ridges out of sight of the sea.) We first tried on spectacles with different colored lenses and light-diffusing filters. The big females didn't care for any of the styles, but the specs had no significant effect on their ability to reach the sea. Next we used glasses with prisms that bent by 90 degrees the light coming into one or both eyes. As you might guess, this caused a good deal of confusion; some of the bespectacled females made it to the water, but others could not find it until the glasses were removed.

These and other experiments demonstrate that green turtles find the sea by visual means alone. "The actual mechanism," says Professor Carr, "is either an inborn response to head for an uncluttered horizon or for the brighter, paler light above the water (sea sky)."

When hatchlings move out from behind a dune or stand of cocoplums, and sky and horizon become clearer, they immediately increase their pace. A wave breaking in the moonlight or

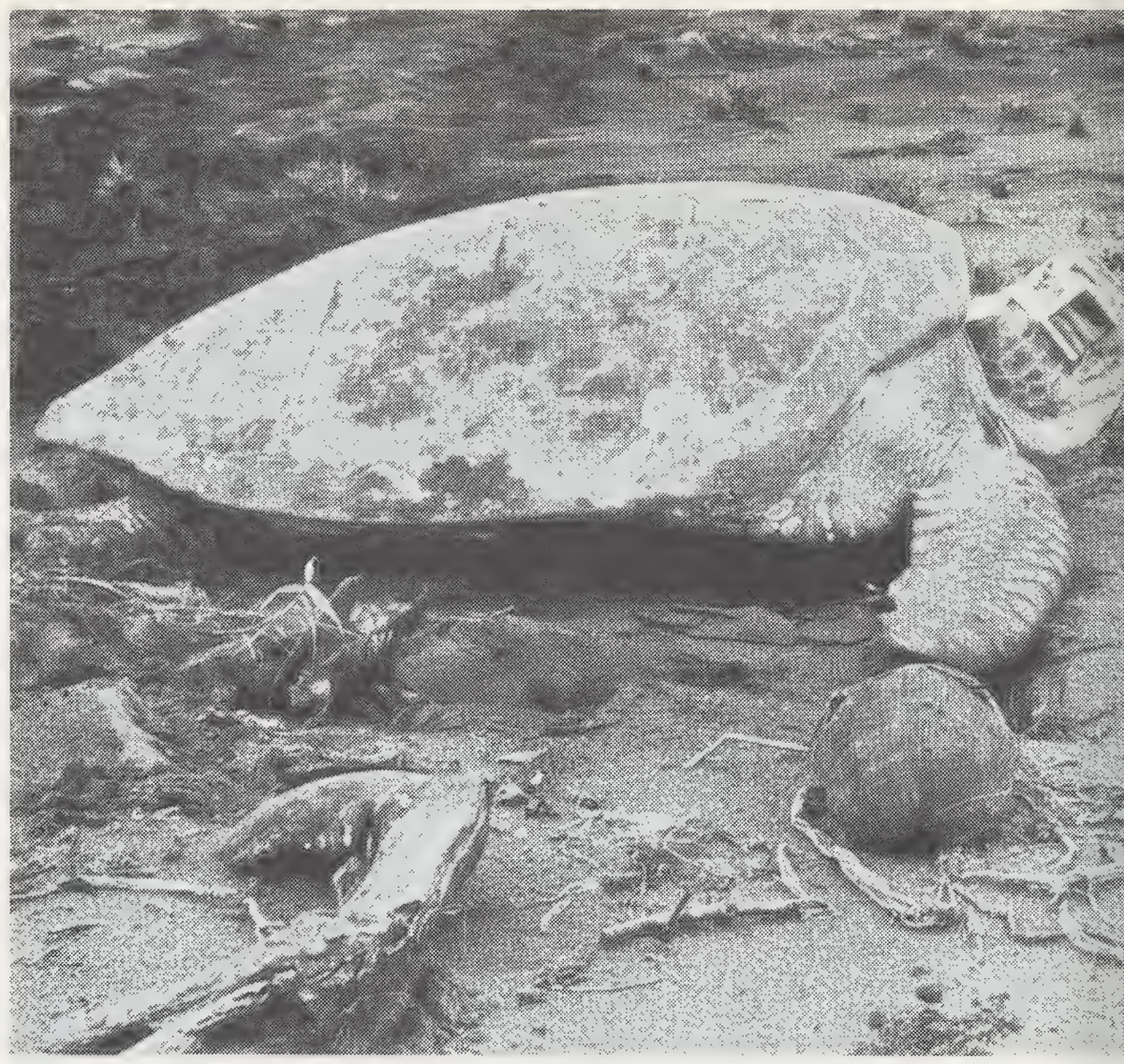
a fiery display of luminescence brings the same response. At the first feel of a spent wave sliding under their flippers, the babies break into excited, uncoordinated swimming motions. After some awkward flapping and flipping in the deepening sheet flow, they get the hang of it and head out to sea with smooth, hurried strokes.

The biggest remaining mystery in the life history of the green turtle is where these babies go. They disappear completely from the ken of man until they return to the nesting beach as adults or groups of youths show up to feed in certain isolated seaweed pastures. Archie Carr comments: "The total disappearance of young turtles during their first year of life is one of the most important remaining gaps in the natural history of the green turtle and one hindering the piecing together of the routes and schedules of their migrations."

When the turtles reach maturity at five to eight years of age, changes in temperature or length of day trigger the instinctive urge to mate and nest. Using information imprinted in their "memory" they retrace the journey to the natal beaches. Since these journeys often involve extended voyages across open water, it is logical to think that turtles take advantage of guideposts in the sky. Starlings, pigeons, night-flying warblers, and even honey bees determine direction by taking bearings on the sun and stars and are even able to compensate for the movement of these celestial signposts.

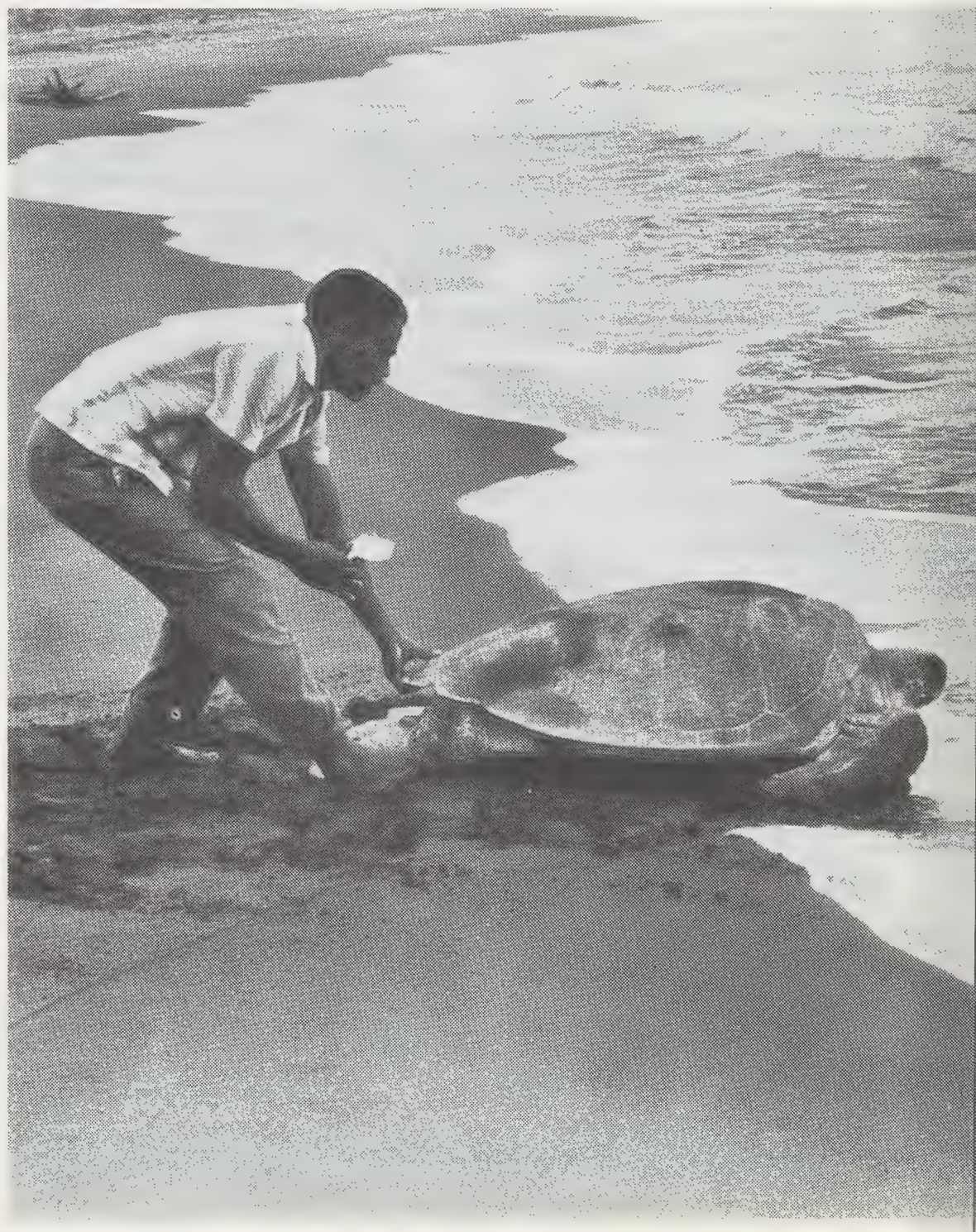
But sea turtles have a problem that birds do not. Retinoscope examinations of immature individuals together with microscopic examination of adult eyes show that green turtles are extremely nearsighted while out of the water. Going from nesting site to the sea does not require any sharp definition of objects since the animals merely head for an uncluttered horizon or generally increased illumination. But their vision is so blurred they cannot locate stars with any accuracy. (Waves make navigation from under the surface highly unlikely.) This does not rule out position finding by the sun or moon, but here turtles run into still another problem.

Even if a turtle maintains a fixed course be-



A bespectacled female turtle moves from beach at Tortuguero to the sea. Research with experimental "eyeglasses" indicates turtles depend on vision alone for this process.

The experiment over, Glenn Martinez removes turtle's spectacles and the animal heads into the surf. After mating season, green turtles voyage to feeding grounds.



tween Brazil and Ascension by sighting on the sun and moon, any drift caused by wind or currents could push it many miles off a direct path to the island. Ascension is but seven miles wide, so even a slight sideward drift during the 1,400-mile swim could cause a reptilian mariner to miss his destination completely.

Archie Carr thinks turtles may overcome this problem by navigating the way that humans did before the invention of precise chronometers (clocks). In those days mariners sailed north or south until the altitude of the sun at noon showed they had reached the latitude of their destination. They then turned east or west and held the same latitude until the destination was raised. You determine latitude by measuring the angular height of the sun above the horizon at noon, or at its highest point of the day. Sailors determine this with a sextant. Professor Carr thinks turtles can do it instinctively. If they can "sense" they are in the right latitude by observing the height of the sun, this would be a remarkable adaptation and would explain how they cross the open sea.

A female turtle could cruise along the coast of Brazil until her noon sights revealed she was at the same latitude as Ascension (7°55′ S). She would then strike out across the open sea. If the sun's height at noon began to decrease, the turtle would know she was drifting southward. She could apply a little right flipper and reshape her course a few points northward. If the sun's height increased she would correct her course with left flipper. In this manner, the mother-to-be would make a zig-zag track across the Atlantic until she picked up whatever beacon turtles use to home-in on Ascension.

This might be the sight of Green Mountain, which reaches an altitude of 5,000 feet and is often crowned with clouds that rise much higher. Or Ascension Island might exude a characteristic scent that is wafted westward on the equatorial current. As Professor Carr says: "Turtles may be able to detect an Ascension effusion in the westbound current far downstream and follow it until they make a landfall."

To determine if these theories about turtle navigation are correct requires tracking them throughout part of their migratory journey. Professor Carr and his colleagues have attempted to do this by tying balloons to turtles and following their movements with transits and range finders. Despite bursting balloons, sounding turtles, and interference by curious fishermen, Carr feels this method is a promising one for short runs. For long hauls radios can be attached to the reptilian mariners without causing harm or interfering with movement. Professor Carr has proposed using a Nimbus satellite to pick up signals from such turtle transmitters. "Tracking Ascension-bound turtles by satellite could easily prove to be the most efficient way of learning the route they follow," he says.

Dr. Carr attaches floats and balloons to turtles.

Animals get different kinds of travel information from their surroundings, just as they obtain different kinds of food. Migrating turtles probably combine information from the heavens with clues from the land and sea.

For millions of years turtles have survived by following these subtle signposts to places where food is plentiful and conditions are ideal for development of the young. Now man's greed for soup and shell threatens them with extinction before we learn what these signposts are. Perhaps every man who tries to find his way across sea, land, or air could profit from this knowledge.

the consumption of wildlife by man

An Editorial by
WILLIAM G. CONWAY

General Director of
the New York Zoological Society

I ONCE KNEW a lady who owned a cheetah. The big cat was graceful, slender, and stately. The lady said she loved the cheetah, though she knew little about the big cat or its habits; certainly she lavished affection on it whenever there was someone about. But I never could tell much about the cheetah's feelings and it died after a few months.

Although all this happened many years ago, the practice of keeping exotic animals as pets has recently increased and, like many zoo men, I have become greatly concerned with the effects of the pet trade on delicate and sometimes rare animals. More than 28 million live wild animals were imported by American pet businesses, laboratories, and zoos last year. More than 22 million pounds of wild animal skins were imported by American furriers and leather goods concerns. United States hunters killed over 60 million birds and mammals at the same time. Man's rising consumption of diminishing wild animal populations shows little sign of abatement and his efforts to manage the wildlife resources on a sustained yield basis are disgracefully inadequate.

When Texas tortoises, South American golden-headed quetzals, and even humming-birds and saki monkeys began to appear in New York pet shops, my concern changed to indignation, a feeling enhanced by the apathetic remark of one pet dealer who, in response to my questioning of his need to sell endangered Texas tortoises, replied, "Are turtles really worth saving?"

The work of unqualified importers of unsuitably rare and delicate creatures results in unnecessary animal suffering, certainly. At the same time, it is important to evaluate the problem coolly and to see the exotic pet trade in relation to additional drains on wild animal populations: food and sport hunting; poaching; pesticide poisoning; hide, feather, or skin trade; and habitat destruction. All this raises questions of critical importance to conservation: of what relative importance is each of the drains on wild animal populations and what are the special characteristics of each?

Naturally, I have been especially interested in problems stemming from the live animal trade. After all, zoos buy live animals too and sometimes from the same dealers that supply pet shops and laboratories. For this reason, I first looked into the trade in living wildlife.

It did not take long to find out that some truly unusual wild creatures were being more or less regularly offered to the unsuspecting pet buyer by even the smallest New York City pet shops. Monkeys are common imports, usually woolly, spider, or squirrel monkeys. "Squirrel monkeys – $13.50," "tame, affectionate – the perfect house pet" said the advertisements. Spider and woolly monkeys are more expensive but still common and even quenons can be found. But I have never seen one of these primates adequately housed or cared for in a pet shop. In fact, so many are kept in such woefully inadequate quarters under such filthy conditions that I wonder if the sympathy thus engendered in the viewer is a sales device. Pet shop sales personnel with whom I have talked have been uniformly uninformed about the biology or the needs of their charges. Several were apparently temporary employees. They knew enough to assure prospective buyers what "wonderful pets" monkeys would make but little else. Most *Animal Kingdom* readers know that almost all monkeys make exceptionally delicate, difficult, and occasionally dangerous pets but these common imports are only a small part of the picture.

During the past year, golden-headed quetzals, South American cock-of-the-rocks, equatorial barbets, Indonesian fairy bluebirds, South American hummingbirds, saki monkeys, and Malayan flying lizards have been offered in New York pet shops. And pet shops are not the only vendors of these exceptionally delicate creatures: even department stores and dime stores have found the exotic pet trade profitable. Emaciated iguanas and anoles clambering over the bodies of their already dead and dying fellows now vie for the shopper's

attention with pencils and plastic flowers. It is remarkable that such relatively rare and expensive creatures as Central American parrots and such precariously delicate ones as tamanduas (arboreal anteaters) and three-toed sloths can be offered in an unregulated way to the public at large. Moreover, all these animals and many more may be ordered by mail from numerous animal supply houses by anyone almost anywhere. Even a child, for instance, can order a dangerous animal.

Undoubtedly, there are good pet shops and suppliers with informed personnel who know their imports and choose them wisely. This is clearly the case with a number of New York businesses which specialize in the sale of tropical fish, and do so most admirably; but they are very few. There are good reasons for importing some species of wild creatures for pets and I, for one, am strongly in favor of wild animal pets. But importation ought to be done carefully and humanely.

After all, the values of a well-chosen, wild animal pet are impossible to duplicate. Wild animal keeping is a historically ingrained activity; it was probably the origin of the development of domestic animals. The pet owner has the pleasure of bringing a living element of far-off wilds into his own home. The beauty or the strangeness of a wild creature which may be examined and observed regularly can provide stimulating intellectual insight and excitement and create a concern with wildlife — and with far-off places. Wild pets properly chosen and cared for can provide recreation and education in the best sense. Surely many a zoologist, amateur and professional, can trace his abiding interest to just such pets. But much of the trade is not being conducted humanely and the animals are not being wisely chosen.

Almost all of the creatures I have named require highly specialized care, constant attention, complex diets, and special conditions of warmth or humidity, shelter and space. Their wild populations cannot, in most cases, be very large, and many will be found to be infected with diseases which require specialized treatment. Some are so sensitive that they must have seclusion while others require company — of their own kind. Many will die within weeks if not days of capture. And I am afraid that many of those that live longer will do so despite the care they receive rather than because of it.

Although the exotic pet trade has tangible and intangible values it must be regulated. Many wild animal populations can withstand well-managed collecting but many rare forms cannot. Moreover, exceptionally delicate or highly specialized animals must not be sold as personal pets whether they are rare or common. The problem is one of cruelty as much as conservation. A few days ago, as I wandered through the pet department of a local five-and-ten-cent store, I happened upon a terrarium filled with "common" horned lizards.

The trade in horned lizards has been going on for decades. Thirty years ago, these creatures sold for 25 cents each; the price is $1.50 now. The unforgivably immoral nature of this piece of commercialization is that horned lizards almost invariably starve to death after a few weeks in captivity. This tells us something about the character of the exotic pet trade for it is well known that horned lizards have highly specialized and poorly understood food and temperature requirements, which few pet buyers could hope to meet.

If pet dealers are properly informed about the animals they sell and solicitous of their well-being, they must know that not even zoos have been successful with three-toed sloths and flying lizards. (The latter have been offered for sale through an advertisement in *Natural History* magazine.) Dealers must know how specialized and delicate such animals as sakis and quetzals are, how rare or delicate cock-of-the-rocks and fairy bluebirds and Texas tortoises are and they must know that these animals are completely unsuitable as pets — and that it is inhumane to sell them as such. They must also know that most of these "pets" will be dead within weeks if not days. Even the endangered Galapagos tortoise and the orang-utan have been sold as pets in this country.

It seems inconceivable that a people whose care of dogs, cats, and horses is watched over by innumerable regulations and protective societies should be allowed to starve, mistreat, and buy and sell rare and delicate wild creatures.

Unhappily, the tale begins to unfold overseas. The live animal business depends mostly upon exports from developing nations and the animals are usually captured by untrained local people. Naturally, many delicate animals perish in the process of collecting, before they ever reach the compound of the exporter. Once there, the delicacy of the species or incompetent care may result in further deaths. Although the captive may be sold in its native land most are shipped abroad.

The urge to cut costs often leads the shipper to pack his wild cargo inadequately. Animals die in their shipping boxes of thirst, heat, cold, starvation, overcrowding, and fighting. When it has been my task to identify birds in a shipment destined for the pet trade for federal officials who wished to be sure that the allotment did not include any obscure prohibited (potential pest or quarantinable) species, I have occasionally happened upon shipments of small birds where 75 per cent of the birds in the shipment were dead upon arrival at the John F. Kennedy International Airport. I am told it is not uncommon for hundreds of birds to be lost in a single shipment. Of course, some species are remarkably hardy during shipment and today most shippers do a thoughtful job of providing for their cargos but, with the truly delicate species, no one can say how many individuals must die in

order to insure that some unsuspecting pet buyer will receive one unsuitable, already doomed pet.

But the pet trade is not the only element in the live animal business. Medical research and pharmaceutical laboratory needs contribute significantly to the drain on wild animal populations. The demand for some species of monkeys is so extensive that it is actually beginning to threaten their future and, consequently, the future of important biomedical research. In 1967, 62,526 wild primates, mostly for laboratory research, were imported into the United States. Although this figure may surprise many, the figures from several past years are far more remarkable. Primate importations for 1958 were 223,000; for 1959, 190,000; and for 1960, 221,000.

Importations in the late 1950s and in 1960 probably reflect the peak years of polio vaccine production. Today, the increasing success of organ transplantation from animals to man poses a new threat to the future of the great apes. For example, each year 30,000 people die from kidney deterioration in the United States alone. If organ transplants become more successful, it is well to remember that the total population of the most abundant large great ape, the chimpanzee, is surely less than 250,000.

The recent expansion of the animal business has been made possible by the airplane. Ninety-two per cent of all wildlife imported into the United States comes by air. Today, it is practical to penetrate almost every wild frontier. An animal far too delicate to intrust to the long sea voyage of former years may now be whisked aboard an airplane and transported to his pet shop destiny before his frail constitutional reserves fail. While this is wonderful for zoos and laboratories prepared to deal with specialized creatures and most advantageous for the animals consigned to them, it simply prolongs the suffering of those species which can go days without food but require specialized diets and care if they are ever to eat again.

An idea of the drain upon the wildlife of an important animal export nation can be formed from the following figures provided by Ian Grimwood for 1964 from Peru. In that year, 39,522 live animals were exported and of these, 26,226 were squirrel monkeys; 6,325 were other small monkeys. Few African nations keep track of their exports but a recent United Nations Food and Agricultural Organization report quoted admittedly incomplete 1962 figures for nine months of live export from Ethiopia as 40,000 birds and 5,283 monkeys. Argentina, by contrast, reports the export of only 28,243 live animals, mostly birds, in the ten years from 1951 through 1960.

Large as all these figures are they pale beside the import figures for one nation, the United States. In 1967, United States imports included 74,304 mammals, 203,189 birds – excluding all psittacines and canaries – 405,134 reptiles, 137,697 amphibians, and 27,759,332 fish. This, reported the United States Fish and Wildlife Service, is the first time that virtually complete records have been obtained at ports of entry.

As a zoo professional, I have looked especially hard at the zoo part of wildlife importation but found that zoos contribute remarkably little to the trade. For example, during the nine years from 1958 through 1966 the total number of ungulates (giraffes, deer, antelope, wild cattle, goats, and sheep) imported by U.S. zoos was only 1,231. As a matter of fact, the world's more than 500 zoos contain a total of only about 500,000 vertebrates. Zoos do not usually conduct terminal experiments and they breed increasing numbers of animals. Several species have been dependent upon zoological collections for their very existence. For instance, the Pere David deer, the European wisent, the Swinhoe pheasant, and the Przjewalski horse are all extinct or nearly so in the wild and dependent upon captive collections for survival.

On the negative side is the fact that zoo demands have contributed importantly to the decimation of the orang-utan. Fortunately, the zoo orang trade has now been reduced by self-imposed zoo boycotts (but orang collecting continues and mothers are still being shot to obtain their babies for the pet trade in their native land).

The total trade in living wild creatures is frighteningly large in the suffering it causes as well as the numbers it devastates no matter who imports what and the next question is: how does it compare with other drains on wildlife populations? What about the traffic in hides, skins, and furs?

Among the most precious and beautiful exhibits at the Bronx Zoo are the snow leopards. Finally, after years of effort, the zoo had just bred snow leopards when I read the following advertisement:

> UNTAMED . . . The Snow Leopard. Provocatively dangerous. Uninhibited. A Mankiller. Born free in the wild whiteness of the high Himalayas only to be snared as part of the captivating new fur collection by. . . . Styled and shaped in a one-of-a-kindness to bring out the animal instinct in you. Call Mr. . . . for your private showing.

Published with a photo of a model draped with two or three snow leopard skins, this ad occupied a full page in *The New York Times Magazine* on August 28, 1966.

The idea of a supposedly sensitive educated woman supporting the slaughter of three to six of these exquisite creatures so that she might show off a coat a dozen times a year, or until the next fashion change, is unacceptably callous. And other ads are easy to find. Neiman-Marcus advertised in a recent *New Yorker,* "Puss and boots . . . prize catch in natural tiger, edged and buttoned in black leather. From our collection of famous fur trophies." It is highly unlikely that there are more than 4,000

Bengal tigers left in all the world! The latest IUCN world population estimates for other tiger populations which are or have been targets for the fur hunter include: The Caspian tiger, 50–80; Amur or Siberian tiger, 250; Javan tiger, less than 25; Bali tiger, 3 or 4; Sumatran tiger, unknown.

And witness another ad affecting threatened creatures:

> A dozen or so terribly spoiled ladies in New York will get this gift for Christmas. . . . Last year's little surprise was a pale blue Rolls to match her eyes. How to top it this year? The "Ultima" II "1200," our twelve hundred dollar travel case of finest African baby alligator [there is no such thing, they mean crocodile]. . .

Until I began looking for fashion advertisements, I never realized how many wild creatures were being senselessly killed to adorn the girl who needs nothing.

What possible justification is there for the fashion-fad slaughter of a wild creature? With what right and what conscience can a civilized woman adorn herself with the mummified reliquiae of diminishing wild creatures? How can she help but see an ugly death in a far-off land, the loss of one more portion of the international resource in beautiful wild creatures, each time she dons her "fun fur"? But, moralizing aside, the conservation question requiring investigation is: how does the hide and skin trade compare to other wildlife uses?

Unhappily, the number of animal lives claimed by the hide, skin, and animal products businesses dwarf the "take" of the live animal business. Often, but not always, different species are involved and where the species is subject to both drains the skin trade is almost always much larger. For example, Peru exported 11,244 ocelot skins in 1964 but only 174 live ocelots. Total skins and hides exported were 247,956 or more than six times the number of live animals; one animal killed for its skin every two minutes, year-round! Again, African figures are difficult to obtain but we do know that more than 26,000 Colobus monkey skins were exported from one Ethiopian port alone in 1961. The total number of animal lives represented by Argentina's official export figures are hard to even imagine. In the decade from 1951 through 1960, the skins and hides of 7,669,758 native animals were apparently exported. It surprised me to find that 104,238 rheas and more than 5,000,000 iguanas were represented in these figures. Here again, the trade in live animals, 28,243, seems relatively insignificant for the same period. Naturally, I began to wonder what part of this importation the United States trade was sponsoring.

Unfortunately, United States customs reports for hides and skins are not usually zoologically specific. They may report hide and fur importation in terms of dollar value and pounds of skins rather than in terms of species and numbers. However, several interesting figures are available. The total 1967 sea shipping weight of imported undressed fur skins was 7,869,000 pounds; the recorded air shipping weight was 2,160,000 pounds. Undressed raw hides and skins other than fur aggregated a weight of a further 11 million pounds for a grand total of nearly 22 million pounds. This does not include the huge trade in finished fur and hide products and leather goods representing wildlife usage by the American market.

Perhaps it is more instructive to examine the tallies for a few more specific groups.

All told, 115,458 ocelot skins, whole, raw, or undressed, were passed by United States Customs last year. They came from seven Latin American countries, the majority from Brazil, Bolivia, and Colombia in that order. A total of 35,748 otters of various species were represented in skins from eleven Latin American countries. Deer and antelope skins imported from Peru, Brazil, Somali, and the Republic of South Africa totaled 970,809. These are evidently all skins of wild animals. And let us not forget that they represent only the consumption of our own country. Who knows what the world totals in wild animal products consumption may be? The point is that the deaths of very large numbers of animals are annually necessary to support the animal products industry and who is to say that the degree of animal suffering in this toll is less than that in the living animal trade? Indeed, *The New York Times* snow leopard article unabashedly uses the word "snared" to account for the capture of the snow leopards, and I doubt that a "quick kill" snare has ever been invented.

Unfortunately the fur and skin and animal products trade is demonstrably endangering a number of species from leopards to blue whales and from tigers to alligators. There is no question that far, far larger numbers of animals are annually destroyed to satisfy this trade than to fill pet stores; there is a very real question whether, in the case of those fashion furs dependant upon wild animal populations, this part of the industry has any redeeming features. This does not mean, on the other hand, that reasonable people can or should quarrel with the reasonable exploitation of wild animals. After all, science uses dead animals too and museum zoologists have amassed large collections. A 1962 estimate of the number of mammal skins in some 307 public and private collections was 1,586,000. The American Museum of Natural History alone has nearly a million bird skins in its permanent collection. But these collections are permanent and basic to our understanding of wildlife.

Today, a very high percentage of all commercial furs sold come from ranch raised mink and fox, animals bred for the purpose. It is not such well managed farming of wild species or, for that matter, the beef and poultry industries that troubles me but the unmanaged unregulated slaughter of diminish-

ing wild animals in the world's few remaining wild areas. The carefully supervised utilization of the fur seal herd in Alaska's Pribilof Islands can scarcely attract criticism. Here, after unregulated slaughter reduced the herd to an unproductive 130,000 animals, careful management and regulated annual cropping has restored the herd to an estimated 4,000,000 seals.

In contrast, the unregulated shooting of tigers, leopards, and jaguars and the failure of whaling nations to abide by whale protection recommendations has resulted in a nihilistic industry which knows full well that there will be no tomorrow and does not care. In a time of almost universal preoccupation with economic values and potentials, it seems incredible that nations and businessmen are allowing the immense renewable resources in wildlife to be mined to a point of no return.

What part does sport and food hunting play in the picture of annual animal use? Thorough studies of hunting patterns and annual kill are characteristic of the American approach to hunting which is, despite its failings, far better managed than hunting almost any place else. The results are figures depicting an enormous annual harvest of wildlife, a managed cropping of a renewable resource that, if sensibly provided for, can be repeated year after year. Nevertheless it is animal killing pure and simple and no better in its humane aspects than the other drains discussed so far. It differs in one especially important way, however, it happens entirely at home.

We can see and act to regulate the depletion of our own wildlife but our commercial sponsorship of the destruction of the wildlife of others passes unnoticed and unchallenged. The few American hunters that pursue their sport overseas cannot, except in rare cases, have a significant effect upon foreign wildlife. However, the sport kill figures from the United States are so immense that they are important in our effort to pull the picture of wildlife use into perspective for they emphasize the enormous human utilization and potentials of some wildlife populations and enable us to guess at the sport toll abroad. The figures for bird kills are especially instructive.

In the 1965–66 hunting season, the United States Fish and Wildlife Service reports that 1,523,600 waterfowl hunters shot 11,986,800 ducks, coots, and geese (over ten million were ducks). During the 1965 season, 900,000 woodcock were also killed, and the estimate for rails and gallinules was 110,000 and for snipe, 387,000. The estimated mourning dove kill, amazingly, was 41.9 million birds. The federal government does not, in general exercise control over nonmigratory wildlife; thus the national figures for mammal kills are less consistent. However, the national kill of white-tail, black-tail, and mule deer in 1966 was 2,020,885. The black bear kill was 23,424.

The lesson here is that some wildlife populations are enormously productive. As a matter of fact, wildlife farming could produce many more pounds of protein from most kinds of land than could ever be realized from herds of the usual domestic animals. In the Transvaal alone, for instance, over five million pounds of meat were produced from wild animals taken under permit on farms in 1959.

Food hunting is not so important as formerly in the United States except for fish, although an enormous number of small animals from frogs and squirrels to raccoons and rattlesnakes must annually be taken for this purpose, especially in the south and west. Naturally, no accurate estimates are available. We must remember that it was food hunting, not sport hunting, that pushed the United States passenger pigeon and Eskimo curlew into the abyss of extinction (and near extinction) and that these events occurred when a larger proportion of the country's population included wild game in its diet than now — significantly, when conditions in the United States approximated those in many developing nations today.

In Africa, Asia, and Latin America, wildlife is an indispensable part of the pot, but an endangered and diminishing part among peoples already referred to as protein starved. FAO reports that over 50 per cent of all fresh meat consumed in the Congo comes from game, more than 80 per cent in Ghana. Those of us who have spent time afield realize that all animals, be it a Colobus monkey in Africa or a cock-of-the-rock in South America are fair game for local menus. There is no doubt that hunting, especially food hunting, accounts for a larger annual take in numbers of animal lives than the trade in live wildlife and the business of furs and skins together, but the first two uses are more necessary than the fur trade.

Although organized, regulated sport hunting does not seem to be a major factor in the permanent destruction of wild species, food hunting is. And, although it may not be fashionable, people have to eat.

The most regrettable part of the food hunting situation takes place on a governmental level where politicians and officials fail to initiate adequate wildlife management and habitat protection measures and simply sit back to watch their burgeoning populations hunt themselves out of house and home.

But there is another, most important, factor in the regular decimation of wildlife: the destruction of habitat.

To a wild creature, habitat means home — a specific kind of area in which to live, to find food, to dig a burrow or build a nest. It is a place with the right temperature, the right amount and kind of water, and the right kind of plants and other animals. When a wild animal is shot, snared for the fur trade, or collected for the pet business,

there is always the hope that there are others of its kind in the wilds from which it came, other creatures which will reproduce.

Wild animals are self-replacing, as long as they have a proper place to live and are not so disturbed or so reduced in numbers that they cannot effectively reproduce. But the key is "a proper place to live." It is not necessary for us to shoot, snare, or collect a single tiger, a quetzal, or an alligator to completely annihilate the species. We need only destroy its forests, drain its swamps, introduce strange animals or diseases with which it cannot compete or survive. We need only alter the chemical balances in its environment or destroy the plants and animals upon which it depends and which in turn depend upon it.

In the United States, 50 million of our original 127 million acres of wetlands have been "improved," With each new concrete expressway, we blanket an average of 50 acres of countryside per mile. In our country alone nearly a million acres of green plants are paved over each year. Indeed we could examine figure after figure from around the world oh-ing and ah-ing over the destruction of rain forests in one part of the earth and deserts in another, the loss of prairies and the destruction of savannahs, the despoiliation of beaches and the draining of marshes, but the evidence is all around us and this scarcely seems necessary. It may be worthwhile to remember that the insidious increase of pesticides in our environment has now proceeded to such a point that not even seals and penquins in Antarctica are free from contamination.

Change in habitat is inevitable is a basis of biology. We cannot stop change; we can only alter its direction, hasten or slow its pace. But it must be our concern to see that a sufficiently rich and varied habitat is retained to provide the scope and opportunity for long term biological change as well as for man's commercial requirements of the moment. Every effort must be bent to prevent the loss of a species. When it becomes necessary to destroy a species or a habitat, as it may, the reasons must be very good ones transcending immediate needs and the act must be performed in the realization that it increases man's mortgage upon his future.

The point is a simple one. Habitat destruction is going on at a fearful pace, a direct result, for the most part, of human population increase. We have only to look at the deserts of the Middle East to see the effects of unregulated human exploitation. Most habitat destruction is, for all intents and purposes, irreversible and the loss of a discontinuous area of wild land is a final one for wild creatures. They cannot continue to reproduce; they cannot continue to find food. The destruction of the forests, jungles, savannas, and swamps is a far crueler business than that we have described in any of man's other activities in wild animal slaughter. At one and the same time, it imposes disease, starvation, fear, and sure death. It is remarkable that these simple facts are so little understood. So many generous persons interested in humane treatment of wild creatures have made large gifts to those generally misguided efforts to move animals into surrounding forests when rising waters threaten them as new dams are created.

What has been lost of first importance is the habitat covered by the waters of the new dam. The suitable surrounding forest will almost always be already filled to capacity with populations of the species threatened by the rising waters. If a census were taken in such an adjoining area before a doomed forest had been flooded and then a year or so later after it had been deluged by escaped and rescued animals, it will almost surely be found to have the same population as previously. The destruction of habitat almost inevitably means the proportional destruction of the animals in it.

Thus fortified with this simplified view, perhaps we can appreciate the factors in man's destruction of animal life anew. Clearly, different species are affected by different trades. Quetzals and monkey-eating eagles and Colobus monkeys are affected directly by the skin trade, by habitat destruction, and to a lesser extent by the live trade. Alligators are affected by the skin trade and by habitat destruction; most hoofed animals by food hunting, habitat destruction, and the skin trade; leopards by the skin trade and habitat destruction. And so it goes. It is clear that the trade in living animals has grown immensely and in such an unregulated way as to be a source of unnecessary suffering if not endangerment to many species of animals. Yet the trade in hides, skins, and furs affecting some but not all of the same species is a much larger source of wild animal destruction and one that is threatening increasing numbers of species. Hunting for sport takes a tremendous number of animal lives but now usually tends to affect species which can withstand this annual "harvesting" better, perhaps, than many of the delicate species in the pet trade and rare species in the skin trade. The total slaughter of wildlife for food obviously takes not millions but hundreds of millions of animals each year. Although we have no overall figures, I think we may safely assume that this wildlife use far surpasses all other direct utilization by man combined. But, in its lasting effect, in the finality of its improverishment, habitat destruction dwarfs all other threats to the existence of wild creatures and ultimately of man. It proceeds in direct proportion to the numbers of its prime consumer, a large mammal increasing at the rate of about 180,000 every twenty-four hours. Today, man's reproductive explosion is the most inexorable and unanswerable menace to the preservation of all life. Considering the cause and the irreversibility of the damage, I see no reason to resist paraphrasing that irritating pet shop manager's question, Is man worth saving?

EXPEDITION SEA OTTER

By C. JACK BARTON

BOTH NORTHERN and southern races of the sea otter *(Enhyrda lutris)* were discovered by Europeans in the first half of the eighteenth century. In short order these sleek animals, so superbly suited to their marine environment, were subjected to mass carnage with resultant dwindling of sea otter populations.

The story of the demise of the sea otter is a tragedy of epic proportions. The Russians are said to have imprisoned Indians from the Aleutian Islands, forcing them to hunt sea otters. The skins were a necessary addition to any wardrobe for the fashion-conscious upper classes of Europe. Even the Chinese demanded the skins, with wealthy Manchurians paying upward of $3,000 for a single pelt in the late 1800s.

The international treaty that was finally written to protect these animals was well enforced with stiff penalties. [Editor's note: Although the treaty was a casualty of World War II, the United States prohibits private hunting of sea otters.] There were a few violations, but the restrictions and shortages of otters caused even discussion of the animals to fade.

A sea otter is the kind of animal, however, that could not stay out of sight forever. Its valuable pelt and entertaining personality are magnetic to hunters and animal lovers alike.

This year the sea otter appeared in publications across the world with the Alaskan Game Commission's "harvest" near Amchitka of otters considered surplus. A thousand pelts were offered for sale during a fur auction in Seattle. Buyers paid as much as $2,300 for individual skins. [Editor's note: No major effort has been recently made to transplant the otters to other suitable islands.]

In the midst of the publicity surrounding the harvest, a group of men from the Seattle, Washington, area quietly went about making arrangements to capture five of the Amchitka area otters for exhibition in the Woodland Park Zoo.

It was common knowledge among most na-

turalists that successful accomplishment of such a task was very difficult; it had been tried repeatedly by game conservationists, and although their dedication and efforts were beyond question, the attempts at long-distance transportation resulted in death for the otters. Two sea otters had been brought to the Seattle area for exhibit—one at Tacoma's Point Defiance Park and the other at Seattle's Woodland Park Zoological Gardens, but these two were the exceptions.

The expedition group included C. Jack Barton, leader; Gary L. Smith; Kenneth McLaughlin; John Benedict; and Dr. Ray Watkins, Woodland Park Zoo veterinarian. The group, composed largely of Boeing Company employees, used the services available at the aerospace firm by consulting with flight engineers in designing the best possible means of transportation. The research ended with the following conclusion: (1) it would be necessary to use a jet aircraft; (2) temperature would have to be held at about 45 degrees; and (3) cabin altitude pressure would have to be kept at less than 1,500 feet.

The airline selected was Alaska Air Lines, presently serving the Aleutian area with the only such jets available. Members of the expedition also talked with officials from the Atomic Energy Commission, which presently controls Amchitka Island. A report was submitted to the federal agency after the expedition returned.

The trip was scheduled for late November, 1967, because a successful expedition depended upon extremely bad weather conditions. High winds and heavy seas often force otters ashore, and it was on the beach that the group planned to make the capture. The weather cooperated; winds hit a high of 75 knots during the week of the capture, with heavy seas, rain, snow, and generally little visibility.

The first morning out was successful, with the capture of a young male sea otter. The animal was named Leroy, after a United States Fish and Wildlife officer, Leroy Sowl, who assisted the expedition during the stay on Amchitka.

The young otter calmed rapidly after capture and began eating squid and fish. In a matter of two hours he was taking pieces of filleted fish from the fingers of the men. He is still the pride of the expedition and has become a favorite with the children who visit the zoo.

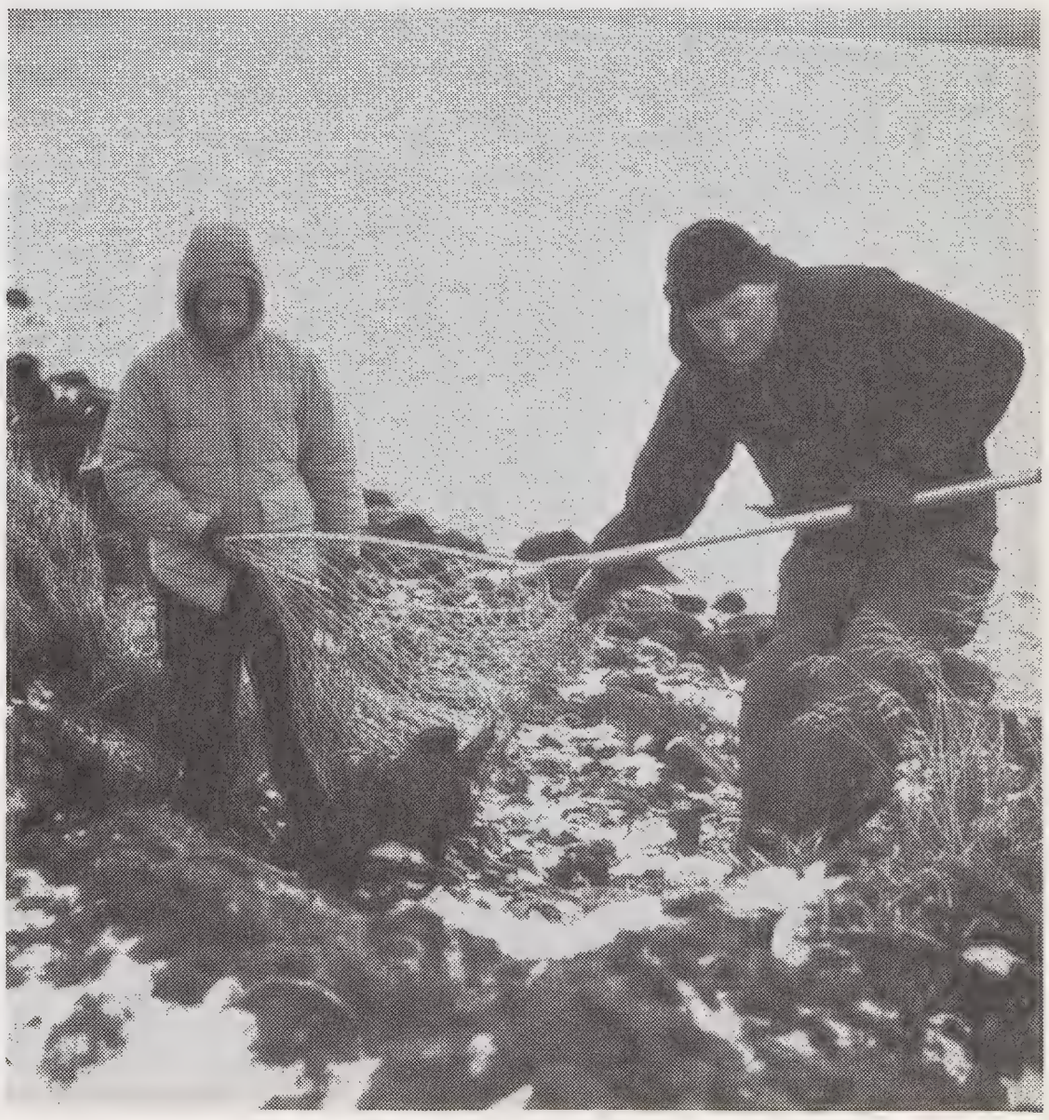
Three days later the crew discovered a bonanza, several mothers and pups in a small rocky area of the beach. Each of the mothers kept her single pup close by, especially when on the rocks. Each pair was perched on a rock so that the mother could grasp the pup in her mouth and drop off into the water if need be.

The two selected for capture were only 50 feet from the hunters, but this distance might as well have been a mile. Capture involved crawling on elbows and knees in 32-degree water for 45 minutes before a hand net could be lifted over the animals.

At that precise moment the female spotted the hunter and grasped the pup in her mouth. The timing was perfect for the hunter; both mother and pup were caught in the net and were pulled back onto the beach to be placed in a cage.

The female fought viciously for their freedom; she attacked with a striking motion similar to a snake's. She continued her fight until

A newly captured otter is carried across the beach.



the pup became overly excited, then paused to hug and caress her small charge; once the pup was calmed, the female otter again began her efforts to escape.

With the capture of the mother and pup, the limits of the permit were filled. The next task was to keep the otters alive and happy until the aircraft arrived for the flight home.

The otters now appear to be smaller than in previous years and thinner than they should be. They travel from beach to beach, apparently depending on weather conditions in search of their natural foods—sea urchins, clams, octopuses, squids, and some fish.

There is evidence of sea otters climbing as much as a hundred feet from the beach into the abundant rye grass. Often their trails lead to fresh water streams; these trails were found by expedition members, who theorized that the otters do occasionally come in for fresh water, and although it is not a necessity for them, it may be a treat.

On November 28, 1967, an Alaska Air Lines 727 arrived on Amchitka to carry the otters back to Seattle. The otters were taken from their holding pen and dried. Since one of the greatest dangers to sea otters is letting their fur become matted from any type of foreign matter, it had been decided to clean them thoroughly and fly them back dry.

The cages were suspended over heavy canvas in a cargo container placed at the front of the airplane. The temperature was dropped in the craft before the otters were taken aboard, then ice was packed around the cages to keep the temperature as low as possible. Since there were also 60 passengers aboard the airplane, it was not possible to lower the cabin temperature below the 45-degree mark. The passengers, employees from Amchitka, has been warned of the cool flight, and all took it with good humor.

The otters took the first leg of the flight to Anchorage with ease, except that they appeared to be dehydrating rapidly with steam rising above the cages.

At Anchorage the cargo doors were opened to let the 14-degree air pour into the cabin. While the passengers deplaned for the warmer

The captured sea otters were held in this pen on Amchitka while the expedition awaited arrival of the plane that would bring the party home.

terminal building, the expedition members gave each otter as much fresh water as it would drink. In each case the otter permitted the men to pour the water directly into its mouth. During the remainder of the flight, each otter was given a glass of water hourly.

The expedition was met at Seattle-Tacoma airport by Frank Vincenzi, director of the Woodland Park Zoo. He took the otters directly to the park. All five animals seemed in good health and were released into a portion of a large enclosure.

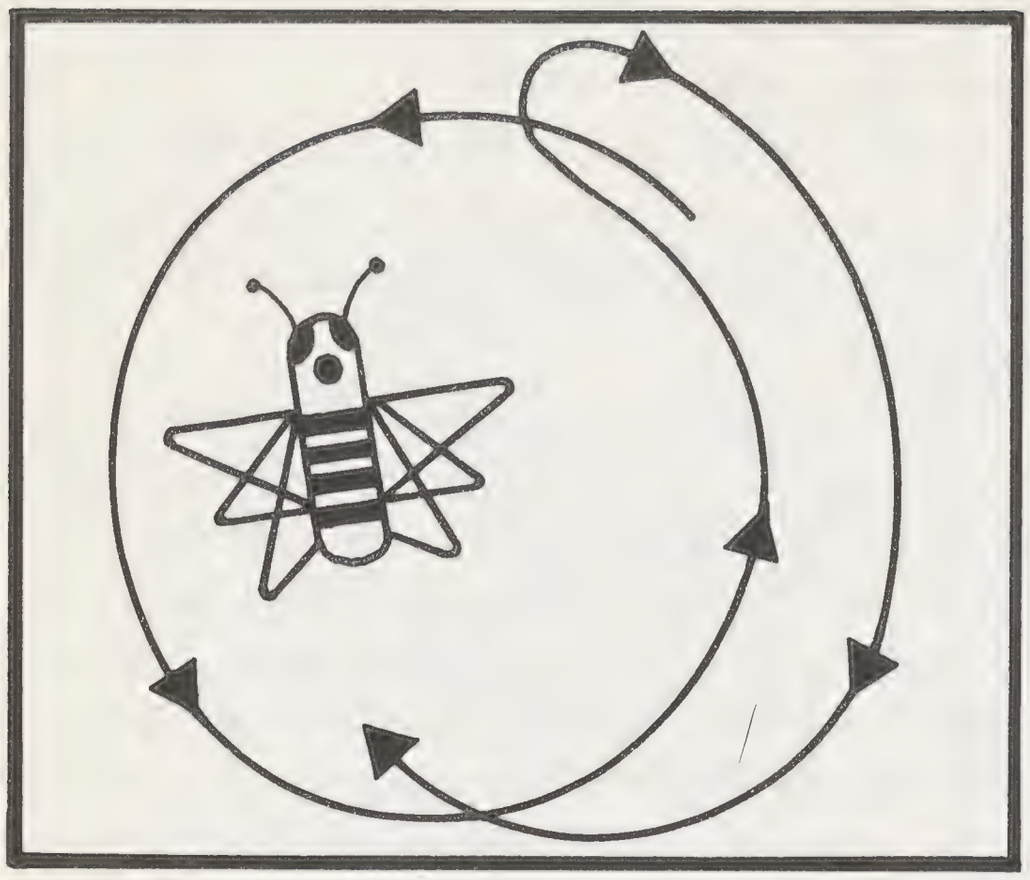
The following morning the five sea otters were on exhibit; for the first time visitors could watch a mother and pup combination in a zoo.

The animals all adapted well to their new environment, swimming lazily in the pool provided for them and feeding on fish, squid, and occasional strips of octopus.

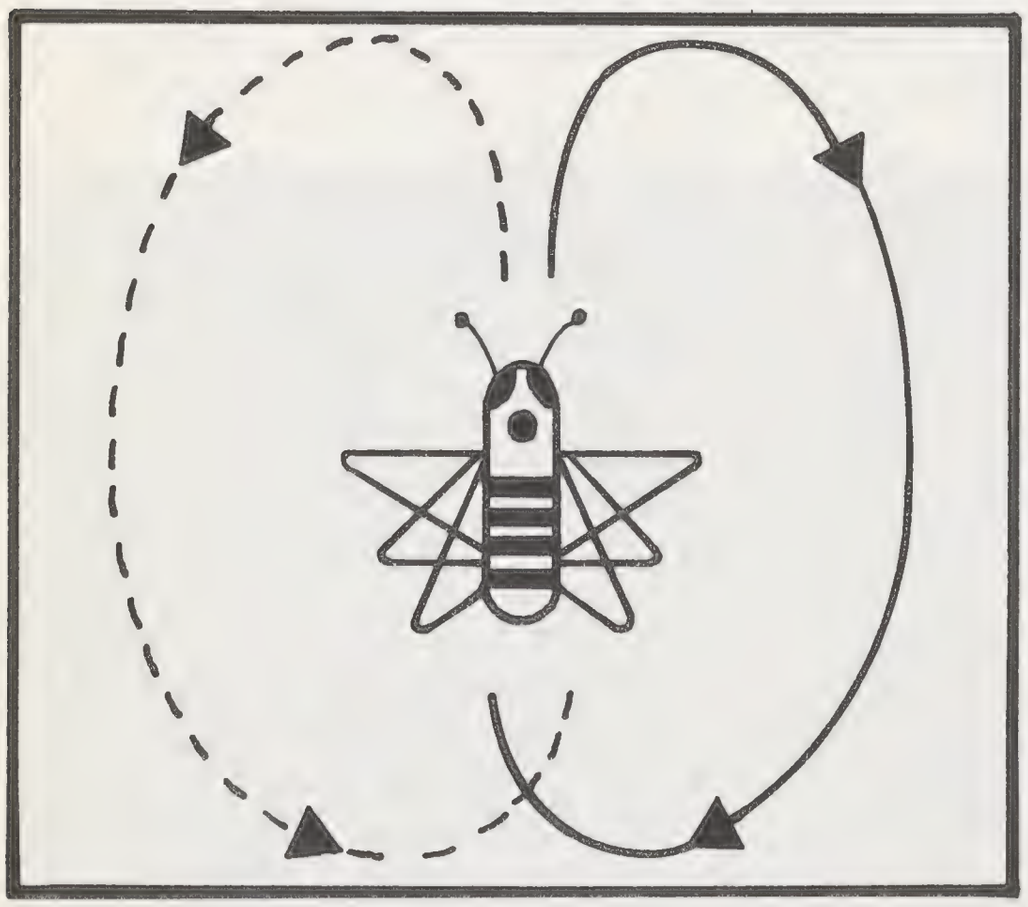
At the sound of the feeding bucket being tapped against a stone wall, the otters gather at the pool edge and wait patiently for the day's cuisine.

The trip opened the door to requests for otters from many more zoos, but the problems of safely transporting them are still not fully answered. This trip, although successful, took two years in the planning and a combination of efforts by numerous organizations and individuals. The successful members of the expedition are in full accord that much more study must be done before the sea otter is ready for placement in all the zoological gardens that would like to have them.

Frank Vincenzi, director of the Woodland Park Zoo, and Gary Smith, a member of the expedition, watch the sea otters settle in at the zoo.



A worker bee signals the nearness of food to the hive by a circular dance.



Food that is far off is reported by the waggle dance of the worker bee.

THE DANCE OF THE BEES

By Edward Edelson

THE BEHAVIOR OF such social insects as the bee has long fascinated man. And certainly one of the most intriguing aspects of bee behavior is the remarkable communication system of these familiar insects. Studies of bees have shown that these insects can communicate messages of surprising subtlety and precision through a combination of motion, smell, and sound.

In fact, the system's major feature, the "dance of the bees," is so unusual that first reports of it were greeted with uniform disbelief by scientists. Even the Austrian zoologist who made the discovery, Karl von Frisch, wrote, "No competent scientist *ought* to believe these things on first hearing." Yet while years of subsequent study have added many details to von Frisch's discoveries, his basic findings remain unchallenged.

Von Frisch made the key discovery in 1944, during one of a long series of experiments with bees that had extended over decades. To test the bees' sense of smell or color, von Frisch ordinarily used dishes of sugar syrup placed near the beehives. This time, however, he put the syrup dishes both nearby and at a distance.

Soon von Frisch noted something unexpected. All the bees that had been marked at the nearby dish—tiny dabs of color were used as markers—were performing what von Frisch calls a "round dance," running in circles. Bees from the far-off syrup dish were all performing

a "wagging dance," running for a short distance in a straight line while wagging their abdomens, then making a 360-degree turn and repeating the run.

Von Frisch had seen both kinds of dances before. But because his syrup dishes had always been placed close to the hive, he had believed that the round dance was performed only by bees who were gathering nectar or sugar water, while the wagging dance was performed by bees who were carrying pollen. Now he suddenly realized that distance, not the type of food, was the crucial factor. That opened the way to another series of experiments in which von Frisch found that both kinds of dance were used by foragers to tell other bees where food could be found.

Von Frisch began moving the syrup dishes to different locations around the hive. At about 50 to 100 meters from the hive, he found, the round dance gave way to the wagging dance. "It was clear," he wrote later, "that the round dance and the wagging dance are two different terms in the language of the bees, the former meaning a source of food near the hive and the latter a source at 100 meters or more."

The two dances differ in basic character. The round dance is a simple notification that food has been found. The foraging bee tells how rich the source of food is by dancing more vigorously and longer for a good source. When the dance is over, neighboring bees fly off in search of food. Their only guide as to what to look for is the scent of the flower that lingers on the original forager.

But the wagging dance, which can be used to guide bees to food sources several miles away, is much more precise. The dance is usually performed on the vertical surface of a honeycomb inside the hive.

The number of turns made by the dancing bee in a given time tells with exactness the distance of the food source. Researchers do not know, however, if the bees use the number of turns per units of time. In von Frisch's original experiments, there were 9 or 10 turns within 15 seconds for a food source 100 meters away, 7 turns for a source at 200 meters, 4½ turns for a source at 1,000 meters. With great care, von Frisch managed to have bees return from sources 6 kilometers—3.7 miles—from the hive; at that distance, the dancing bee made only 2 turns in 15 seconds.

The direction of the food is indicated by an equally precise, but even more remarkable, method. The straight run of the wagging dance is done in the vertical direction—but not precisely. The dancing bee orients the straight run at the same angles to the vertical as the angle it flew with respect to the sun while heading home. If the dance is straight up, the message is to fly directly toward the sun; if it is at a 15-degree angle to the left of vertical, it means "fly 60 degrees to the left of the sun."

This may seem hard to believe, but it has been confirmed in myriad experiments. It has been shown that the bees somehow have a built-in chronometer. As the sun moves in the sky, the angle of the straight portion is altered appropriately.

Other experimenters have shown that the dance of the bees is also used in the most crucial decision the swarm has to make—the location of a new hive. As the time to swarm comes near, some of the foraging bees begin looking for likely hive locations, rather than for food. They are then seen crawling into holes, cracks, and nesting boxes. A scout that has found a likely spot returns and begins the wagging dance.

Nearby bees, aroused by the dance, fly off to investigate the spot. If they find it suitable, they also begin a wagging dance that indicates the same place.

The decision to swarm is made carefully, usually after a number of potential locations for the hive have been investigated. Martin Lindauer, a colleague of von Frisch's, has seen more than 20 different sites considered by a single swarm. At times, several different groups of bees are dancing for different sites.

The final decision, Lindauer found, is made by a remarkable form of democracy. The swarm will not move until all its scouts agree on one site—insect government by consensus. In only two cases did Lindauer find swarms unable to agree. In one case the dancing was resumed after an abortive attempt to swarm, and all the scouts eventually danced for the same site; in the other case the swarm did not build a hive, but instead built honeycombs in the bushes where it had rested.

Since von Frisch's first experiments, other researchers have found that the sounds emitted by the bees during their dance may also be used for communication. During the straight run, the bee emits a buzzing sound. Careful study of the buzz showed that it consists of a "train" of sound pulses with a frequency of about 32 per second. The average length of these sound trains, as well as the average number of pulses in each train, was found to be proportional to the distance the bee had traveled from the food source.

Other sounds are also vital to the life of the hive. One is the warning burst emitted frequently by bees guarding the hive when an intruder approaches. Another is the "piping" beep emitted by some worker bees in response to disturbance outside the hive. The sounds emitted by queen bees in their cells allow the workers to control the release of the queens.

Von Frisch's work was done at first with the black Austrian honeybee, *Apis mellifera carnica.* Later work with other varieties have shown that dialects in the language of the bees do exist. The Italian honeybee, *A. mellifera lugustica,* for instance, uses the round dance only for food sources within about 10 meters of the hive. Between 10 and about 35 meters, the Italian bee does a sickle-shaped dance, with the opening of the "sickle" facing the food source. Beyond that distance, the Italian bee uses the wagging dance. When the Italian and Austrian honeybees interbreed, the offspring usually follow the practice of the parent they resemble most.

An Indian relative of the European bees, the giant bee *A. dorsata,* changes from the round dance to the wagging dance at about 5 meters. An Indian dwarf bee, *Apis florea,* has a much different dialect. These bees build colonies no bigger than a man's hand on the upper branches of small trees. The dance is performed on the upper rim of the colony, where bees are packed into a mass that forms a horizontal landing place. Since the dance is on a horizontal surface, it is oriented directly to the sun, rather than to the force of gravity used on vertical surfaces.

The existence of these bee dialects and a study of more primitive species have enabled scientists to draw up a tentative history of the evolution of bee language. *A. florea,* the dwarf bee, appears to use a primitive form of the dance. It can perform the dance only on a horizontal surface and within sight of the sun. When Lindauer, who was studying the dwarf bee, put two pieces of cardboard over the colony in an "A-shape" roof, the bees, unable to see the sun, became completely disoriented. Only a few even attempted to dance.

The more advanced European bees, however, can perform their dance both inside the hive on a vertical surface and outside the hive on a horizontal surface in sight of the sun. After puzzling over the method by which the bees oriented themselves to the sun, at times even on a cloudy day, von Frisch found that they could sense the polarization of light. Ordinarily, light waves from the sun vibrate in all directions. In the atmosphere, however, certain planes of vibration are favored, and it is this phenomenon that the bee detects.

Honey bees negotiate the surface of a honey comb in an observational hive at the Institute for Research in Animal Behavior, Bronx Zoo.

The bee must see a patch of clear sky, however small; in experiments that allowed the bee to see only a small part of the sky, the insect became disoriented when a cloud passed across that area.

Primitive bees without this orienting ability still can communicate with varying degrees of efficiency. The stingless bees of the subfamily Meliponini use less advanced methods than *Apis*, but some are just as effective in bringing bees to food sources. Some stingless bee species use humming sounds to alert the hive to food finds, but without transmitting information on direction and distance.

One species leaves a scent trail to lead bees to the food source. This species' foragers put scent marks on twigs or bushes at frequent intervals. Other bees from the hives follow the trail until they find the source of pollen. The alert comes when the forager bee arrives at the hive and runs about excitedly; the sounds it emits apparently are the means of alerting its hive mates. In other species of stingless bees, the forager leads its colony mates partway toward the food the first time, after which they find their own way.

In these food-hunting activities, as well as in other activities of the hive, the bees make full use of the principle of feedback—that is, the activity is largely self-governing. When the source of food is rich, the dancing bees perform enthusiastically, attracting many gatherers. As the source is used up, the dancing becomes more sluggish, and fewer bees respond. Thus, the effort of the bees is exerted where it is most effective.

An even better example of this is the method by which the honeybees maintain the temperature of their hives at a constant level despite wide variations in the outside temperature, something that is vital to the life of the hive. They can keep the temperature of the hive's brood cells constant within 1° centigrade, the best temperature regulation found among the insects.

On cold days, the bees will cluster together over the brood cells, producing heat by muscle vibration. On hot days, the temperature is kept down by evaporation. Water is brought into the hive and distributed to bees who spread it over the brood cells and fan their wings to evaporate it. As the water evaporates, it is replaced. Obviously, the need for water rises rapidly as the outside temperature goes up, and a highly coordinated method of meeting that need has been developed.

Ordinarily, the bees that spread the cooling water are supplied by foraging bees. When more water is needed, the hive bees take an emergency measure and dip into their honey stomachs for the nutritious solution they ordinarily use as a food reserve. As this is used up, they begin begging their neighbors for water by stretching out their proboscises and tapping their antennas. As this begging movement reaches the hive entrance where the nectar collectors gather, some of the collectors begin bringing water rather than nectar. At the same time, they recruit other water foragers by dances.

As long as the need for large amounts of water continues, it will be met. When the need drops, however, the water collectors become aware of it quickly. Instead of being relieved of their water with speed, they find fewer and fewer takers. As demand drops, the foragers stop their recruiting dance and return to gathering nectar.

It is tempting to see in this highly controlled activity and precise communication something akin to human intelligence. But this is not the case. As von Frisch has written, "The brain of a bee is the size of a grass seed and is not made for thinking. The actions of bees are mainly governed by instinct. Therefore the student of even so complicated and purposeful an activity as the communication dance must remember that he is dealing with innate patterns, impressed on the nervous system of the insects over the immense reaches of time of their phylogenetic development."

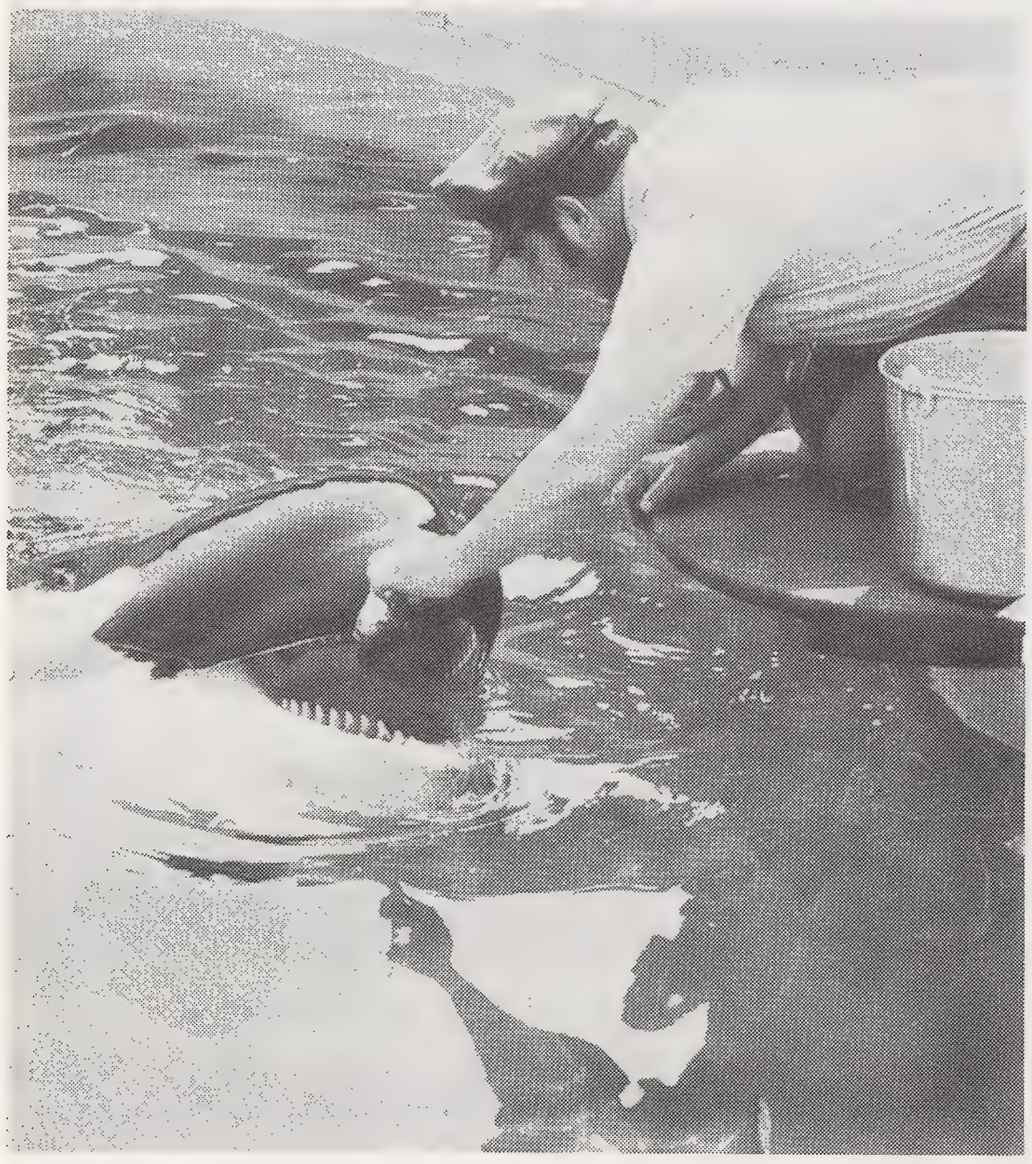
Accepting this, and knowing how the language of the bees evolved from the rudimentary methods of primitive bees to the symbolic dance of the honeybee, it is still possible to be impressed by the sophisticated and complex behavior of such a small inhabitant of our planet.

animal kingdom

NEWS OF ZOOS, AQUARIUMS, AND CONSERVATION

REPORTS

KILLER WHALE



One of the largest whales in captivity—a huge killer whale—has been placed on exhibit at the New York Aquarium.

The whale, a female named "Lupa," arrived at the aquarium early on April 1, after a cross-country flight by jet freighter.

The 18-foot-long sea mammal, weighing 5,800 pounds, was airlifted to the John F. Kennedy International Airport from Seattle, Washington, aboard a United Air Lines DC-8F.

The whale has been placed in the aquarium's "Polar Bay," a large outdoor pool formerly occupied by several gray seals. The animal is the first of its species exhibited on the East Coast. The New York Aquarium obtained the killer whale, a female, from the Seattle Marine Aquarium, which recently caught the animal in the waters of Puget Sound. Killer whales—so called "wolves of the sea"—range in large packs through most of the world's oceans.

A New York Aquarium keeper hand-feeds "Lupa," the killer whale. Eighteen feet long and 5,800 pounds, she is one of the largest whales in captivity. The huge animal was airlifted to New York City from Seattle, Washington, and is the first killer whale exhibited on the East Coast.

Unforgettable Beebe

The July issue of the *Reader's Digest* magazine will carry an article by Dr. Fairfield Osborn on the late William Beebe, famed director of tropical research for the New York Zoological Society. Dr. Osborn, who was a close friend of Dr. Beebe, is president of the society.

Dr. Beebe's explorations and research in the depths of the sea and the interior of tropical jungles are described by Dr. Osborn in the *Digest's* "My Most Unforgettable Character" feature.

IN MEMORIAM: Frank G. McInnis

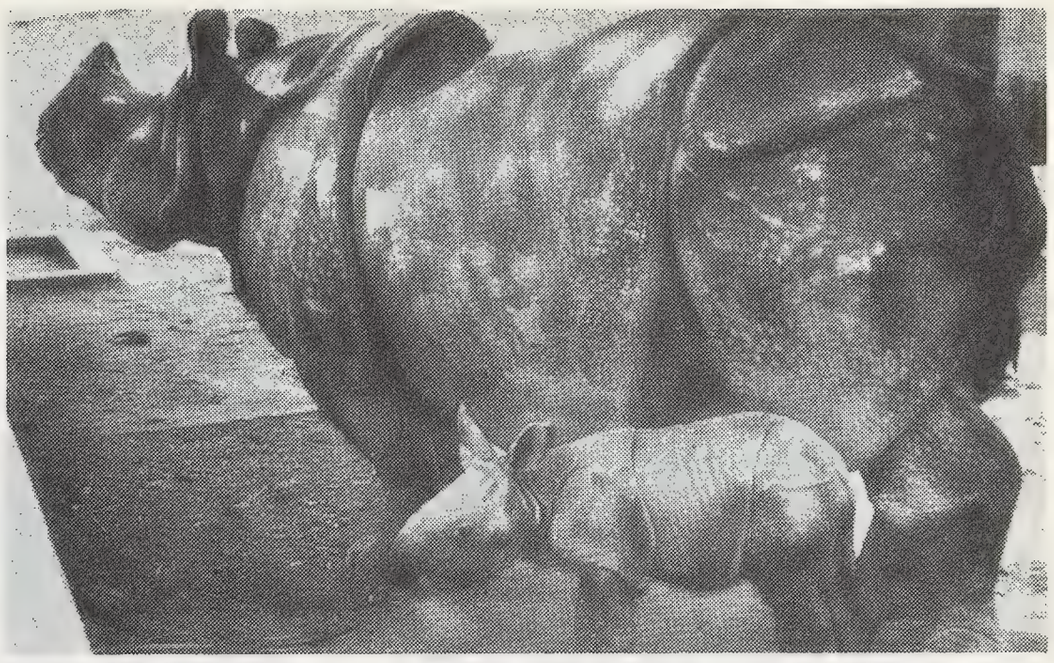
Frank G. McInnis, director of the Detroit Zoological Park, died on April 4, 1968. Born in 1901, he eventually chose landscape gardening as a career and after graduating from Michigan State University, he joined the Detroit Zoological Park in that capacity in 1929. Designed by the noted German zoo family the Hagenbecks and operated under the direction of John Millen, a former Hagenbeck employee, the then recently opened zoo was an almost solid mass of concrete construction. Under the administration of Frank McInnis, these structures were soon softened or blotted out by handsome plantings and rolling lawns, a condition that still exists today.

With constant exposure to animal exhibits and the animal's welfare always in mind in the formation of designs, Mr. McInnis soon found himself more zoologist than landscape planner. When the regime of John Millen ended in 1944, Mr. McInnis succeeded him. During the following 24 years, the Detroit Zoological Park upheld and enhanced its standing among the great institutions of this country.

A mere outline of his career cannot do credit to this unusual man. Tall, handsome, and dignified, Frank McInnis did much to raise the status of his profession and was repeatedly honored. He was president of the American Association of Zoological Parks and Aquariums (1952-53); president of the parent organization, the American Institute of Park Executives (1959-60); and chairman of the administration board of the National Recreation and Park Association (1966-67). He was also a founding member of the Wild Animal Propagation Trust.

He was awarded the Cornelius Pugsley bronze medal for outstanding achievement in zoological park design and in December, 1967, he received the gold medal of the American Institute of Park Executives.

Mr. McInnis is survived by his wife, Mary Ella, and their children, Douglas and Barbara.



INDIAN RHINO BORN

There are only about 600 Indian rhinos in the wild, according to India's Sri Chamarajendra Zoological Gardens (the Mysore Zoo). So zoo men in Mysore were naturally excited when, on February 13, a young male calf was born to the zoo's Indian rhino female, "Rani."

The calf, at birth, was "the size of a nine-month-old pig," brown in color with white facial marking at the site of the horn in mature animals. Only about a dozen Indian rhinos have been born in captivity.

ABOUT THE authors

Alexander Skutch is a well-known ornithologist based in Central America. **Dominic Crolla** is well known on the American science writing scene. **William J. Cromie** is a science writer and editor who works out of Houston, Texas. **William G. Conway** is general director of the New York Zoological Society. **C. Jack Barton** was a member of the sea otter expedition. **Edward Edelson** covers science and medicine as a free lance writer.

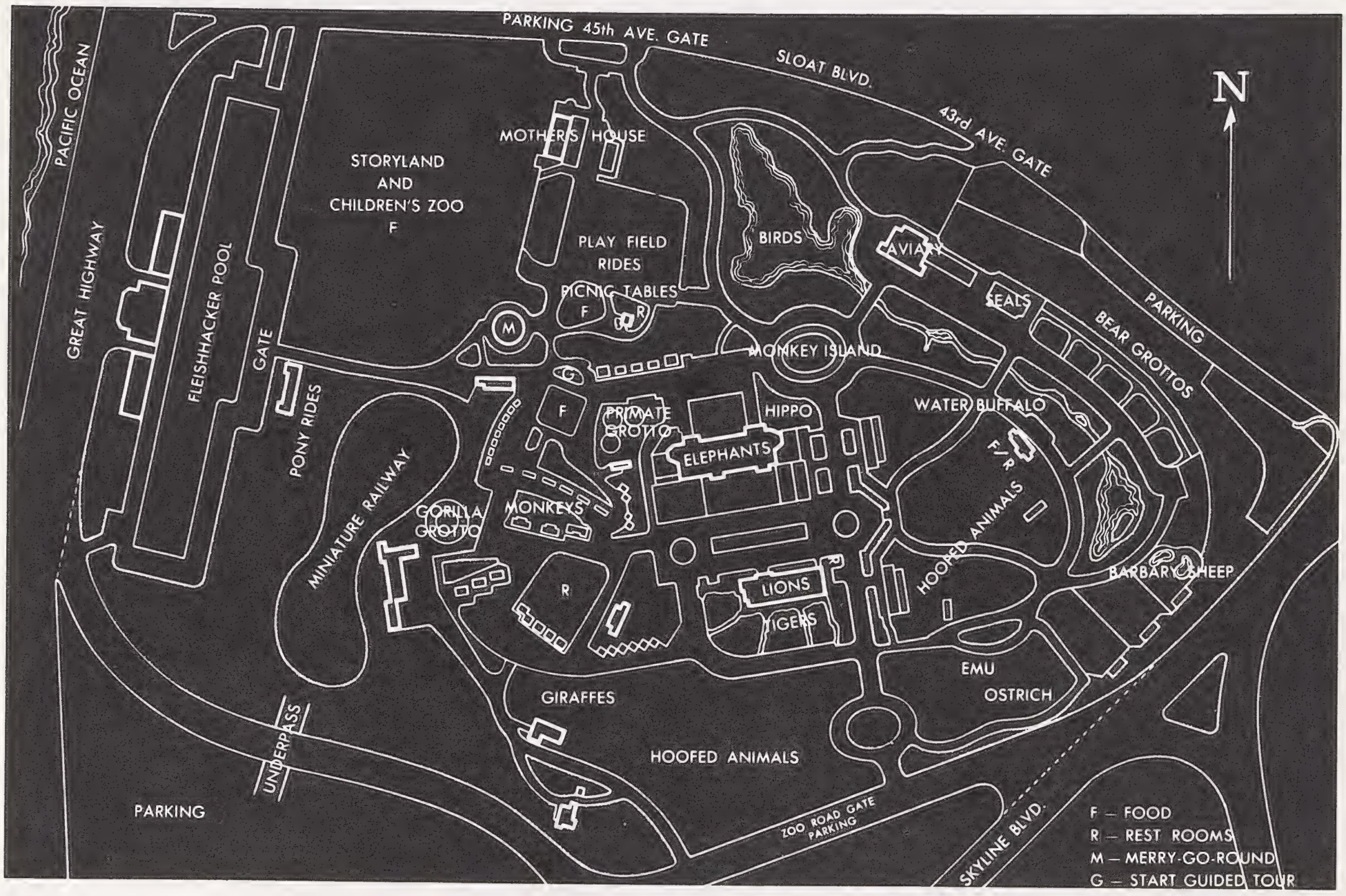
ILLUSTRATION CREDITS

Cover – N.Y.Z.S., Sam Dunton; pp. 4, 6, 9 – N.Y.Z.S.; pp. 10-12 – Dominic Crolla; pp. 14-17 – William J. Cromie; pp. 24-27 – C. Jack Barton; p. 29 – Hugh Spencer, National Audubon Society; p. 31 – N.Y.Z.S., William Meng; p. 33 – N.Y.Z.S.; p. 34 – Geeta Studio.

Design by B. J. Johnson

VISITING SAN FRANCISCO, CALIFORNIA ?

The San Francisco Zoological Gardens exhibit more than 1,000 specimens of mammals and birds. The zoo is open daily from 10 A.M. to 5:30 P.M., admission is free. Koala bears, exhibited in their natural habitat of eucalyptus trees, are one of the zoo's highlights.



This is one in a series of travel guides to zoos and aquariums presented by ANIMAL KINGDOM as a service to its readers. We welcome submission of maps and information to be used on this page.

NEW YORK ZOOLOGICAL SOCIETY

70.673
59

VOL. LXI, NO. 4, AUG., 1968

animal kingdom

NEW YORK ZOOLOGICAL SOCIETY

630 Fifth Avenue, New York, N. Y. 10020

Fairfield Osborn
President, and Chairman of the Board of Trustees

Laurance S. Rockefeller
First Vice-President, and Vice-Chairman of the Board of Trustees

Robert G. Goelet
Vice-President and Chairman of the Executive Committee

Henry Clay Frick, II
Vice-President

Howard Phipps, Jr.
Secretary

Harold C. Palmer
Assistant Secretary

Eben W. Pyne
Assistant Treasurer

BOARD OF TRUSTEES

(Executive Committee)*
Alexander Aldrich, George F. Baker, Jr.*, Robert E. Blum, William R. Coe, C. Suydam Cutting, John Elliott, Charles W. Engelhard, Henry Clay Frick, II*, Robert I. Gannon, Peter R. Gimbel*, Robert G. Goelet*, Peter Grimm, John N. Irwin, II*, Warren Kinney, Anthony D. Marshall, Otto Marx, Jr., David Hunter McAlpin*, Peter Matthiessen, G. W. Merck, Charles W. Nichols, Jr.*, Fairfield Osborn*, Augustus G. Paine, II, Howard Phipps, Jr.*, John H. Phipps, John Pierrepont*, Eben W. Pyne, Laurance S. Rockefeller*, David T. Schiff, John M. Schiff, Henry Sears, Chauncey Stillman, Joseph A. Thomas, Landon K. Thorne, Jr., Alfred G. Vanderbilt, Robert Winthrop

Ex-Officio:
The Mayor of the City of New York
Hon. John V. Lindsay

Administrator of Recreation and Cultural Affairs
August Heckscher

General Director
William G. Conway

ZOOLOGICAL PARK

William G. Conway, *Director & Curator of Birds;* Charles P. Gandal, *Veterinarian;* Hugh B. House, *Curator & Chairman, Mammals;* Grace Davall, *Assistant Curator, Mammals & Birds;* David W. Nellis, *Mammalogist;* James G. Doherty, *Mammalogist;* Joseph Bell, *Associate Curator, Birds;* Donald F. Bruning, *Ornithologist;* F. Wayne King, *Curator, Reptiles;* Herbert J. Knobloch, *Curator, Education;* Charles B. Driscoll, *Superintendent, Operations;* Edward Kearney, *Manager, Facilities Dept.;* Joseph A. Davis, Jr., *Scientific Assistant to the Director;* Lee S. Crandall, *Zoological Park Consultant & General Curator Emeritus;* William Bridges, *Curator of Publications Emeritus;* Roland Lindemann, *Consultant, Mammal Management;* John M. Budinger, *Consultant, Pathology*

AQUARIUM

Ross F. Nigrelli, *Director;* Nixon Griffis, *Administrative Assistant to the Director;* Robert A. Morris, *Curator;* Lars Mellkvist, *Superintendent;* Jewell Bungay, *Business Manager;* Louis Mowbray, *Research Associate, Field Biology;* Christopher W. Coates, *Director Emeritus*

OSBORN LABORATORIES OF MARINE SCIENCES

Ross F. Nigrelli, *Director;* Martin F. Stempien, Jr., *Assistant to the Director;* George D. Ruggieri, S.J., *Coordinator of Research;* William Antopol, C. M. Breder, Jr., Jack T. Cecil, Harry A. Charipper, Kenneth Gold, Myron Jacobs, Klaus Kallman, Vincent Liguori, John J. A. McLaughlin, Martin P. Schreibman, Eva K. Hawkins

INSTITUTE FOR RESEARCH IN ANIMAL BEHAVIOR

(Operated jointly by the Society & Rockefeller University)
Donald R. Griffin, *Director;* Peter R. Marler, Jocelyn Crane, Roger S. Payne, Richard L. Penney, Fernando Nottebohm, George Schaller, Thomas T. Struhsaker, C. Alan Lill

WILLIAM BEEBE TROPICAL RESEARCH STATION

O. Marcus Buchanan, *Resident Director*

GENERAL

Walter Lerchenfeld, *Comptroller;* Bernard M. Fagan, *Accounting Manager;* John McKew, *Personnel Manager & Assistant to the Director, Zoological Park;* Gordon Cuyler, *Membership Chairman & Administrative Associate;* Jerry M. Johnson, *Curator, Department of Exhibition and Graphic Arts;* Edward R. Ricciuti, *Editor & Curator, Publications and Public Relations;* Joan Van Haasteren, *Editorial Assistant;* Dorothy Reville, *Photo Librarian;* Sam Dunton, *Photographer*

AFFILIATE

Jackson Hole Biological Research Station
L. Floyd Clarke, *Director*

ANIMAL KINGDOM STAFF

Edward R. Ricciuti Editor and Curator, Publications and Public Relations
Joan Van Haasteren Editorial Assistant
Jerry M. Johnson Curator of Exhibition and Graphic Arts
Dorothy Reville Photo Librarian
Sam Dunton Photographer
William Meng Photographer

animal kingdom

MAGAZINE OF THE NEW YORK ZOOLOGICAL SOCIETY VOL. LXXI NO. 4 AUGUST, 1968

ABOUT THE COVER

Front: Komodo monitor. With the possible exception of the giant snakes, no other living reptile has been the subject of such colorful tales as the giant Komodo monitor. F. Wayne King, author of the article on page 2, recently observed the giants of Komodo in the wild.

Back: Imperial angelfish, *Pomacanthus imperator* (right), and longnose butterflyfish, *Forcipiger longirostris* (lower left).

(This issue of *Animal Kingdom* represents a milestone in that the type in the magazine has been set by computer. The setting of type by computer is a major advance in the printing industry.)

CONTENTS

ORA—GIANTS OF KOMODO 2
by F. Wayne King

SNAKE VENOM 10
by N. J. Russell

GENETIC PHENOMENON, THE FORMOSA MOLLY 13
by Klaus D. Kallman

THE MONTREAL AQUARIUM 20
by Arthur Fisher

LEE S. CRANDALL
60 Years at the Bronx Zoo 24

DELICATE OPERATION ON PACHYDERM 26
Photographs by Sam Dunton

ANIMAL KINGDOM REPORTS 28

THE BOOKSHELF 31

ABOUT THE AUTHORS 32

ILLUSTRATION CREDITS 32

Issued bi-monthly by the New York Zoological Society at the Zoological Park, Bronx, N. Y. 10460. Editorial and Subscription Offices at the same address. Title registered with the U. S. Patent Office. Subscription, $3.50 a year; single copy, 60 cents. Same rates for all foreign countries and Canada. Second-class postage paid at Bronx, N. Y. Send Form 3579 to Bronx, N. Y. 10460.

©1968 New York Zoological Society. All rights reserved.

Printed in U.S.A.
by Clark & Fritts, Inc.

ORA—S OF KOMODO

BY F. WAYNE KING

SOME 50 FEET farther down the ravine, the crunching of dry brush announced the approach of a massive Komodo monitor lizard. The big reptile was attracted by the scent of the bait suspended from a tree only a dozen feet from my hiding place behind a small tree. The sounds in the brush stopped as a lizard, more than seven feet long, emerged from the bushes. For a few moments it remained by the edge of the brush, cautiously looking around, before it moved up the ravine to join a smaller, six-foot-long monitor already tearing at the bait.

Up close the thick hide of the monitors resembled a suit of mail with its large rivet-like scales. The folds of skin on the neck behind the head looked very much like the top of a turtle-neck sweater, and I could even count the ticks embedded between the scales on the monitor's sides.

When the lizards walked they held their body and much of their tail clear of the ground, but as soon as they stopped to feed or peer about, the hindquarters were dropped to the ground so that the reptiles seemed to be sitting upright. Seen from the front, a monitor in this posture looks like the caricature of the bulldog often seen in cartoons. The image is further enhanced by an enormous potbelly that rests on the ground when the animal sits, and nearly touches the ground when a large adult walks.

These monitors are the world's largest living lizards; males reach a record length of 10 feet 2 inches and females, 7 feet 6 inches. These big reptiles, which weigh up to 250 pounds when adult, live only on the islands of Komodo, Padar, Rintja, and Flores in central Indonesia. Americans incorrectly call them "dragons" because of their size, while the Indonesians living on the island of Komodo call them "Ora."

A grant from the Charlotte Fondaras Wildlife Protection Fund had enabled the New York Zoological Society to send me to Komodo to estimate the size of the monitor population. My mission was to determine if enough monitors remain there to warrant a major study of their behavior and ecology—an investigation that the zoological society estimates should take at least a

year. At the same time, a preliminary trip to Komodo would help determine the extent of the logistical effort that such a study would demand.

The envisioned study could be critical in ensuring the survival of the giant monitors, believed by many conservationists to be threatened with extinction—fewer than 1,100 are thought to exist. Like other unfortunate large reptiles, especially island dwellers, the Komodo monitors cannot withstand exploitation—of either them or their habitat. The Ora are protected by the Indonesian government but until more is known about the behavior, ecology, and life history of the animal little can be accomplished in the way of a management program to maintain the powerful lizards.

The Ora have been protected to varying degrees since 1915, three years after the lizards were discovered. Rintja, Padar, and Komodo are set aside as reserves where all hunting, even of wild pig *(Sus scrofa)* and Rusa Deer *(Cervus timorensis floresiensis)* on which the monitors feed, is banned. Hunters from a nearby island, Sumbawa, still poach a few deer in western Komodo but even this is being curtailed, and the Ora can only be collected under government permit.

Several expeditions have been dispatched to Komodo to observe or collect monitors since the reptiles were discovered but these have added little to the meager data on the animal. Most field studies have involved only a matter of a week or so on the island and it would take considerably more work of this type to document all aspects of the monitor's biology. The most detailed information about these animals concerns their anatomy and morphology, and this has been obtained from preserved museum specimens.

So basic a piece of data as the size of the animal's home range—necessary for an accurate estimate of the monitor population—is lacking. So are details on mating behavior, frequency of breeding, number of eggs produced, and where the clutch is deposited; this makes it difficult to predict reproductive potential. Other important but missing facts about the monitors involve their activity cycle, temperature and humidity requirements, size of young at hatching, growth rate, and the time it takes the lizards to mature. Although it is known the animals feed on pig and deer, their exact diet is unknown. So is the lizard's lifespan.

All these unknowns mean that it is extremely difficult to maintain—and even more so to breed—the Ora in captivity. And unless captive animals survive and produce young, the cause of conservation is not served. For the collection of zoological specimens must not continue to be a drain on the wild population but must contribute to the next generation of Ora, just as the wild reptiles do. The Indonesian government has since 1956 permitted collection of only 12 monitors every three years. This harvest of live animals, it is hoped, will not endanger the continued survival of the species and yet will give the outside world a glimpse of the giant. At the same time, no one really knows what effect, if any, removal of these few animals has on the wild population, or even how the few human residents of the island affect the monitors.

In early April I left New York City to join an expedition to Komodo. The 10 members of the expedition assembled in Surabaja, Java, and included the author; Jim Kern, a nature photographer from Florida; Hilmi Oesman, a member of the board of directors of the Surabaja Zoo in Indonesia; and Widodo Soekohadi, a conservationist from the Office of Nature Conservation and Wildlife Management, Bogor, Indonesia. As a member of every major expedition to Komodo since 1961, Hilmi has spent a total of three and one-half months on the island and probably knows more about the wild Ora than any other man alive.

We had been able to charter a 45-foot, wooden-hulled freighter, a dirty, weather-beaten

An outrigger canoe ferried supplies to the base camp on Komodo from the motor ship anchored offshore in Telok Sawa (Python Bay).

craft with the lines of a Gulf of Mexico shrimp trawler, for the 500-mile trip to Komodo. We sailed from Surabaja on April 13, anticipating a trip of three days at the freighter's unspectacular seven knots, top speed. We were in for an unexpected, but not unpleasant, interlude.

A day and a half out of Surabaja, not far off the northern coast of Bali, the members of the expedition lazed about the deck in the mid-afternoon sun, sleeping or reading, when the slow, methodical thumping of the ship's engine turned into an ear-shattering tatoo. Amid the flurry of excitement on deck, the ship's engineer revealed that the drive shaft had broken, setting us adrift in what would have been a dangerous area if the seas had been rough. A similar accident the year before had been disastrous for the crew and passengers of a ferry boat off the east coast of Bali. Five hours later we were taken in tow by a passing military boat and brought into Bali, where we spent an unplanned week. I could not help but muse, who would believe we had been accidentally "shipwrecked" on Bali and not accomplished it by prior arrangement.

Eventually we had to seek another boat to complete the trip, since the new drive shaft threatened to burn out the old bearings in the motor.

We had our first glimpse of Komodo 10 miles off the north coast as dawn broke April 26. The island is about 22 miles long north-south, 12 miles wide east-west, and has a rugged appearance when seen from offshore. Its seemingly nude hills, peaks, and intervening valleys call to mind a crumpled piece of aluminum foil. We arrived at the end of the rainy season when the island was starting to dry out.

Komodo is very arid, with no permanent water on the lower parts of the island, except for a well in the small village of Komodo on the western shore of Telok Sawa, "Python Bay". The central mountains rise 2,412 feet, high enough to cause winds to drop their accumulated moisture as rain, but not high enough to do this with any regularity. Streams flow only during the rainy season from late November to March, and even then are apt to disappear into a dry bed before reaching the sea. Locating fresh water must be one of the greatest problems facing Komodo wildlife.

The vegetation—at this time of year yellow-green to gold in hue—reflects the scarcity of water. Most of Komodo is covered with grass

This view of the interior of Komodo shows the grass-covered slopes of the island's hills. The grass conceals rough terrain covered with rock and rubble.

and scattered Lontar palms. The island's only large expanse of forest—largely thorny scrub—occurs on the upper reaches of the mountains where the rain is more frequent. On the lower parts of the island, thin gallery forests wall the dry stream beds and ravines. The trees are widely spaced, do not form a closed canopy, and are seldom over 40 feet tall. The rolling grassy slopes with their tall palms call to mind a golf course at some tropical country club. But the golf course appearance is deceiving. Beneath the waist-high grass is a rough, eroded surface of volcanic rubble, and hiking across the sun-baked fields involves stumbling into numerous small gullies and stubbing toes against rocks hidden in the grass. Meanwhile the blistering sun rapidly reminds you of the necessity for water.

The Ora avoid excessive loss of water and extreme high temperatures by staying primarily in shaded areas where the trees are most dense—the dry stream valleys and ravines on the lower parts of the island and the forested slopes of the central mountain ridge. The monitors also seem to be slightly more active in the morning and afternoon than at midday when the sun is most intense. The same is true of the mammals, especially the wild pigs, which come down the shore to root around in the mud flats and tidal wrack just before dusk

each evening. At that time hardly a quarter mile of beach lacks a pig searching for a morsel of seafood.

We set up a camp of tents near a dry stream bed 200 yards from the northeast corner of the bay.

Our first day was spent exploring the grassy northeast part of the island, and although we saw no monitors in this area, we did see tracks in the sun-baked mud of a mangrove flat. Hilmi led us to a grassy hillside immediately adjacent to the mangrove flat. There, no more than 20 feet above the high-tide mark, the Ora had dug six or eight burrows, each within 10 feet of the next.

Isolated burrows or dens of Komodo monitors have been photographed and described but only Hilmi and Mr. Hartojo, the director of the Surabaja Zoo, had seen this cluster of burrows before. Another cluster of 14 burrows honey-combed the face of another, nearby hill. Each burrow, approximately 20 inches wide and 15 inches high, ran straight back into the compacted gravel and volcanic ash. The entrances would have been hidden under the tall grass except for a wide, flat, excavated terrace in front of each burrow. We could not determine how far back into the slope the holes extended, or if they had side branches or rooms.

One of the questions an ecological study of the Ora would answer is what purpose these burrows serve. Since the monitors are the dominant carnivore on the island, the burrows probably do not provide the usual protection from predators. However they might protect the lizards from the extreme high temperature or low humidity of this dry island. Moreover, the clusters suggest that they might play a role in the social behavior of the lizards.

The next day we hiked into the Vai Liang stream valley to photograph the Ora. This valley has been the trapping site for most of the collecting expeditions and many of the scientific expeditions to the island (see *Animal Kingdom*, 1956, LIX[2], 34-42). It is a flat, wooded valley extending from the central mountains to the northwest corner of Telok Sawa. The stream bed runs along one side of the valley and it frequently narrows to a 15-foot-deep ravine whose vertical sides cut into

Hilmi Oesman (wearing hat) of the Surabaja (Indonesia) Zoo follows a guide—a Komodo villager—on a trek into the open forest of the island's interior. This is the Vai Liang Valley, in central Komodo, where a large concentration of the giant monitors is found.

Bait was hung in a tree-lined ravine (below). Less than 2 hours later, the first monitors appeared. The lizard above is almost seven feet long.

the valley floor. The tallest trees and densest tangles of vegetation grow in the ravine, making the temperature there slightly cooler than in the surrounding, more open areas.

We hung a dead goat from a tree in the ravine as bait to attract the lizards. It had been killed three days earlier, and now was the source of an overwhelming stench. The bait was suspended just out of the monitors' reach, because we did not want it eaten before some large adults arrived. The first Ora came to the bait only an hour and a half later, and I have to admit I was a bit disappointed that it was only a slender six-foot-long animal. A lizard of this size should impress anyone, but I had hoped the first Ora would be an impressive nine-foot male. To make matters worse, this one was in the bottom of the ravine and 100 feet away, which made it look even smaller than it was. It plodded up the stream bed with the side to side swaying characteristic of large four-legged reptiles until it was beneath the bait. There the monitor sat

without actively trying to reach the meal overhead.

Within a short time it was joined by another specimen a bit smaller, and then by one approaching eight feet in length. When the larger individual approached the bait tree, the smaller Ora moved away into the brush. One of them moved up the ravine and into a patch of sun, where it collapsed on the sand to soak up warmth.

The larger lizards were a nearly uniform gray-brown to black in color, but the juveniles and young adults were brightly marked.

The back of a young Ora is gray-black with a scattering of light spots, and the tail is alternately banded with light gray and black. The throat and belly are orange. Most of the color fades, however, by the time the animal has reached six or seven feet in length.

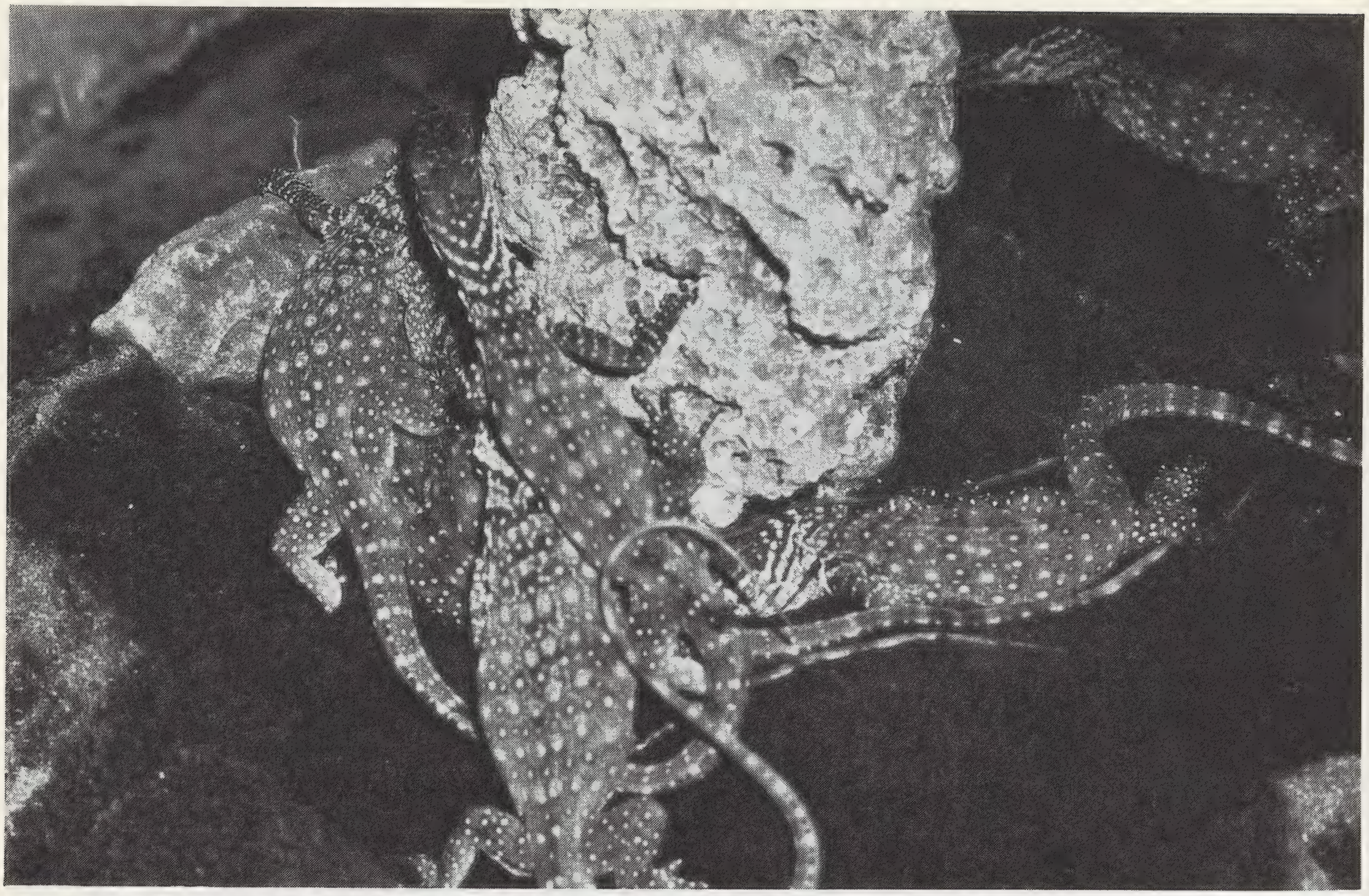
Hilmi told us that it was not necessary to construct a blind from which to photograph the monitors, because once they start feeding they pay little attention to their surroundings. He said you could simply crawl close enough to take any photograph you wanted, or even measure them with a steel tape. This sounded improbable since other expeditions had used photographic blinds, but the events of the day proved Hilmi's statement to be true.

During the morning we had the bait tied high out of the lizards' reach so they could not eat, and as a consequence we could only photograph them from the top of the ravine. When we tried to get closer, the lizards fled into the brush.

At midday we lowered the bait to the ground, where the monitors could rip pieces free and gulp them down. Soon all the lizards became intent on the feast at hand and ignored us, as long as we moved slowly. We crept forward while they fed, freezing each time one of them looked our way. When they turned back to the bait, we moved again. In this manner five of us moved to within 25 feet of three of these impressive animals.

Each lizard, holding its body high off the ground, would seize part of the goat in its mouth and rear backward to tear some meat free. This action frequently was strong enough to almost lift the goat off the ground. Occasionally a piece of

Two large monitors (the one in the foreground is almost eight feet long) photographed by the author on Komodo. The huge potbelly of large Komodo monitors rests on the ground when the big reptile sits and almost drags on the ground when the animal walks.



These young Komodo monitors are the product of the first breeding effort of the giant lizard in captivity. Twenty-eight monitors were hatched June 1 at the Jogjakarta (Indonesia) Zoo. This photograph is one of the first published of the young. Zoos hope to learn enough about the Komodo monitor to establish successful breeding programs.

flesh came free so suddenly after a struggle that it would surprise the monitor, which would dash off four or five feet and look frantically about for some nonexistent enemy. Some of the Ora got a mouth full of goat hair, instead of meat, for all their efforts. When this happened the lizard walked off a few steps and scraped the sides of its partly opened mouth against the ground in an attempt to clean its teeth and jaws.

I continued a bit closer until I was less than 10 feet from one. I could have moved even closer, but further movement would have brought me not only closer to the lizards but also nearer the rotten bait, the smell of which was already overwhelming. I decided, therefore, not to advance further and stayed where I was.

I could not help but wonder how fast an Ora could run while I was sitting that close to the two that remained. I was not worried about being attacked by them, since they were more intent on feeding than on being aggressive, but they do have sharp claws. I remembered that one of the specimens formerly in the Bronx Zoo once tried to climb up the leg of zoo photographer Sam Dunton. It took 56 stitches to close his wounds. I did not get a chance to worry about it, because the lizards had had their fill of goat meat and moved slowly into the brush and out of the ravine.

About two-thirds of the goat remained. It had been disemboweled, and one hind-quarter had been torn free and swallowed by a seven-foot monitor. Similar observations have been made by other expeditions, but descriptions of how the lizards tore a pig or deer in half tend to exaggerate their strength and the sharpness of their teeth. They certainly are strong, but in each case the bait used was rotten meat. The goat we used was three days old and the flesh was putrid and could have been dismembered by a strong man pulling on a leg.

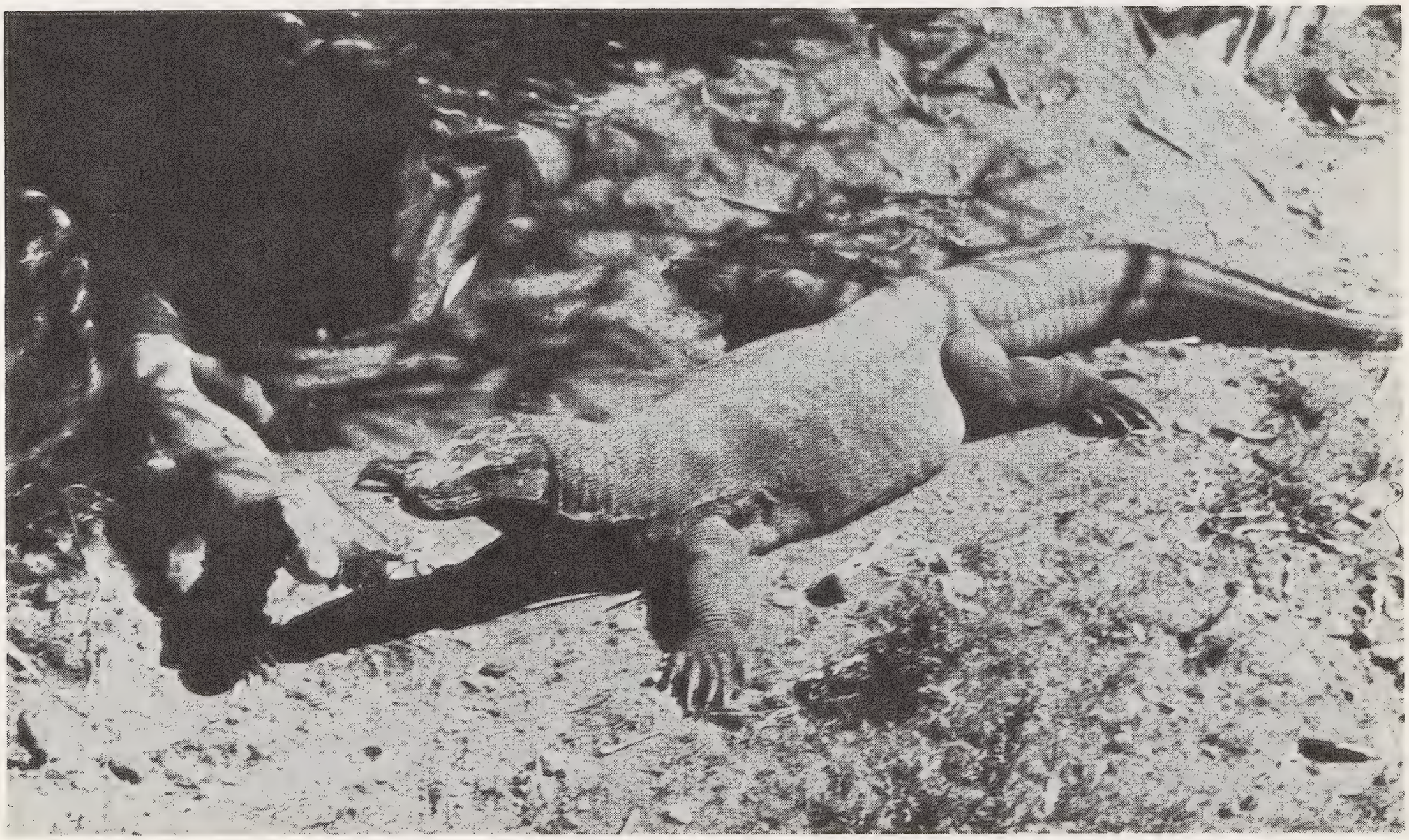
This calls to mind another unsubstantiated "dragon fact" constantly repeated in the literature. All the expeditions to Komodo have baited the lizards into photographic or gun range, or into collecting traps, by using rotten meat. Fresh meat does not attract the lizards, but the odor of rotting

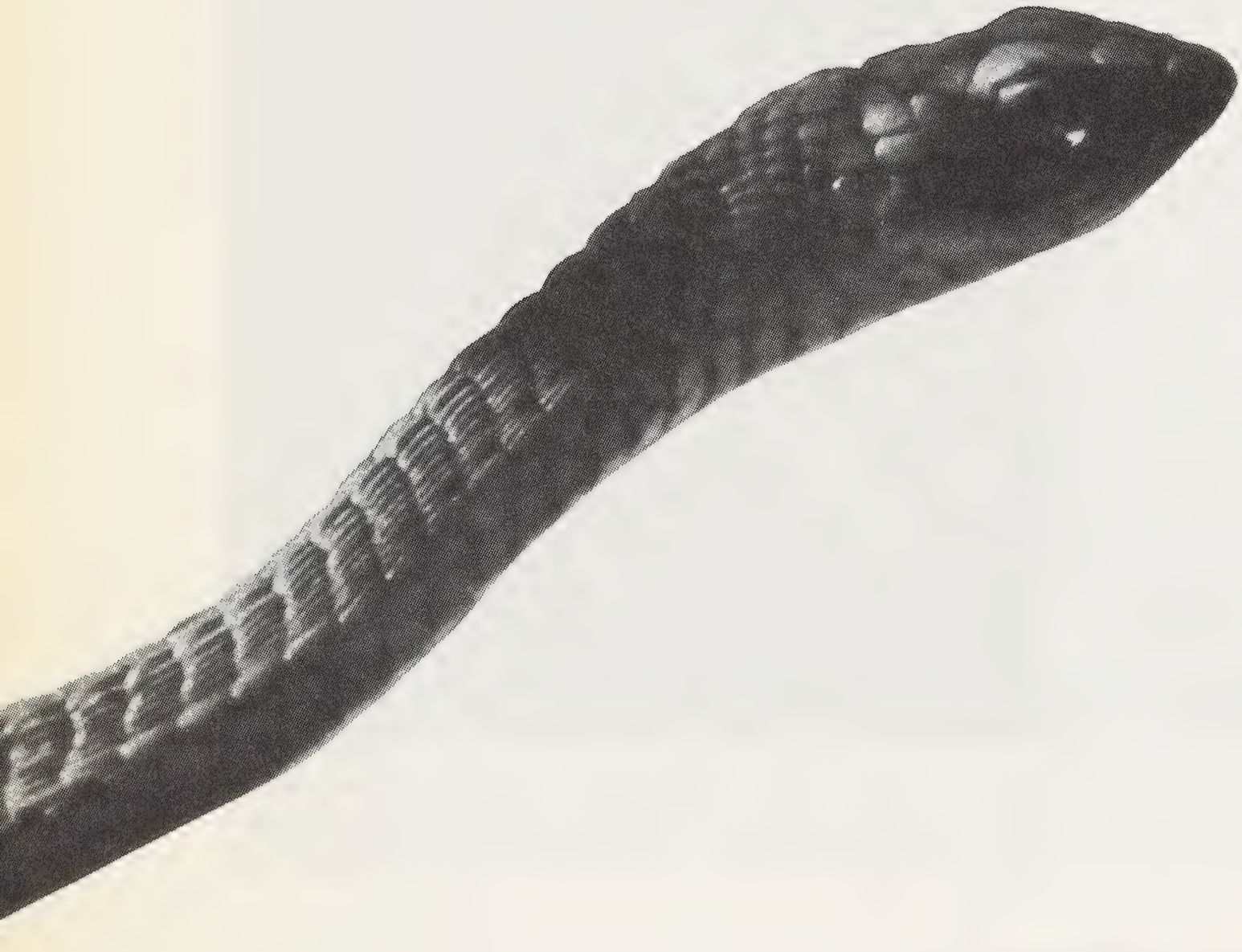
meat brings them from afar. This suggests strongly that the Ora are scavengers. Yet scientists have stated that the monitors catch and kill the numerous pigs and deer found on the island. No one has seen them catch live prey in the wild, but on two occasions people have staged the event for camera crews. Once by disabling the prey and once by dubbing the film to make it appear that the lizards were chasing deer. There are observations that suggest the young monitors feed on the eggs of the megapode birds found on the islands, and it seems certain that both young and adults will feed on anything that they can catch. But if you sit in the woods of Komodo and listen to a large monitor crash and rattle its way through the underbrush, you will begin to doubt that it can sneak up on living prey. So until someone sees one pull down a deer or pig (or macaque or horse on Rintja), we should consider adult Ora to be primarily carrion feeders.

The New York Zoological Society may clarify some of these questions about the Ora with a future study. Certainly the study of so fascinating an animal is long overdue.

The hatchling in this photograph taken at the Jogjakarta Zoo is a month old. When adult the Komodo monitor may measure more than 10 feet (males) and weigh 250 pounds.

These adult Komodo monitors are the parents of the young hatched at the Jogjakarta Zoo in June. The male (right) is about nine feet long.





SNAKE VENOM

BY N. J. RUSSELL

RESEARCH started in Nairobi, Kenya, and now under way in Glasgow, Scotland, on the venom of the green mamba suggests that the powerful anti-coagulant element in the venom may be separated and used to combat thrombosis, the formation of a blood clot in the vessels or the cavities of the heart.

There is little need to elaborate on the frequency with which this type of clot—a thrombus—kills people in the prime of life, striking often with a lack of warning.

The research started in 1965, when a group of doctors from Glasgow University arrived in Kenya to help set up a medical school in the African nation. Some of them undertook venom research as a side-benefit of assignment in a country endowed with some of the world's most venomous snakes.

The physicians had the full benefit of Nairobi's snake park, where the curator, James Ashe, provided them with quantities of venom from his regular snake-milking sessions. Puff adders, green and black mambas, boomslang, and carpet vipers were available for venom and study.

A small frame laboratory adjacent to the Kenyatta National Hospital on the outskirts of the city was put at the researcher's disposal, and here the research team carried out its studies.

The venom researchers had to discard a lot of misinformation and sift available scientific fact; the chemical composition of venom is far from simple, and it causes varied reactions when it enters the blood stream.

For example, the boomslang's venom is highly dangerous, yet C. P. J. Ionides, of Tanzania, an authority on snakes, gets no reaction from it.

However, the great American herpetologist, Karl P. Schmidt, died after he was bitten by a boomslang. James Ashe has also been bitten by a boomslang, without much result. He has also been bitten by the rhombic night adder, not normally fatal. However, the bite of a night adder proved deadly to another victim in unusual circumstances. The victim sucked venom from the bite of a friend in an effort to treat him, forgetting that he himself had a raw throat at the time.

Some snake handlers gain a measure of immunity from a particular snake venom if they survive the first bite. Others have been known to reach the stage at which they have been subjected to so much antivenin that they are in more danger from antivenin than from venom.

The use of venom has also been promulgated as a cure-all, with a variety of results, ranging from fatal to hopeful. It is on record that in the late 19th century, diluted rattlesnake venom was used to treat alcoholism, gangrene, and meningitis, with uncertain results. Rheumatoid arthritis has been treated with moccasin venom with claimed success, while the venom of the Russell's viper has been used to promote coagulation of the blood. Cobra venom has been used in small doses as a pain killer.

In order to establish the basic possibilities, the Glasgow group restricted its research to venom's effect on blood.

They discovered that the venom of the boomslang, carpet viper, and puff adders contains a coagulant fraction, causing the blood to clot. The venoms with an anticoagulant fraction are those of the mamba and cobra, with the green mamba having the most powerful anticoagulant of all, although its venom is not normally as dangerous as that of the black mamba.

Of more interest to humans is the fact that mamba venom is highly potent—particularly that of the black mamba *(Dendroaspis polylepis)*—and acts quickly, giving much less time for antivenin treatment than, say, that of the puff adder.

One of the most inaccurate ways of trying to identify snakes is by color. In East Africa the black mamba is rarely black at all, although sometimes a pure black specimen is found in South Africa. Farther north it is usually a putty or khaki color, or sometimes pale green.

Perhaps it should more accurately be called the black-mouthed mamba, for in its defensive posture the black inside of the mouth is quite noticeable. It flattens its neck slightly and has a disconcerting switchback movement in retreat. Unfortunately, this can be misleading, for the snake uses the first part of the same motion occasionally when about to strike, swaying sideways and backward, then scything forward in a level arc.

The black mamba lives in low thickets, favoring those on top of anthills, from which it preys on small rodents and mice (the black mamba has been known to eat bats). In turn it is preyed on by the larger birds and wild cats such as the serval, genet, and caracal. Another enemy is the mongoose.

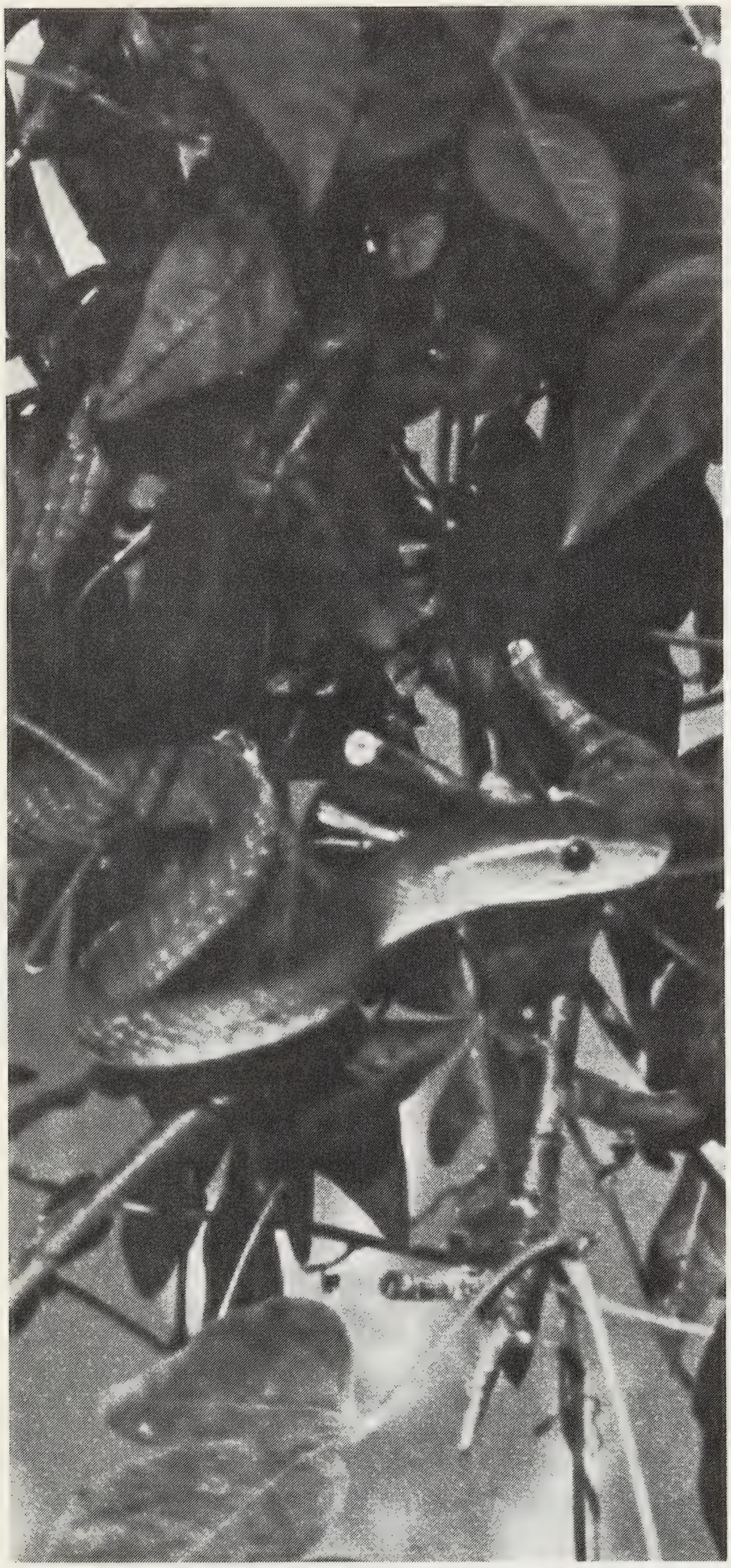
A common fallacy connected with the 10-foot long black mamba concerns its speed. Fiction relates that the black mamba chases humans at about 30 miles per hour. Fact cuts its speed to a quarter of that, but the snake can reach seven miles per hour through thick bush, which a man cannot. In the open, however, the mamba's speed is reduced to about five miles per hour.

Of the green mambas, the *Dendroaspis jamesoni* is least dangerous and is found in the western region of Kenya on the shores of Lake Victoria. *D. angusticeps*, however, which grows to about seven feet, is found in south and central Africa and along Kenya's coastal areas. Both are more nervous snakes than *D. polylepsis* and so more of a danger to humans. As a warning, all three give a high-pitched hiss, distinct from the lower-pitched warning of cobras and vipers.

The warning of the boomslang is very obvious, although the snake itself is seldom seen, for it is very placid. The boomslang blows its neck out like a balloon. To give it its scientific name, *Dispholidus typus* comes in a variety of colors, including bright blue, but according to James Ashe the females may be brown and the males green.

It is found all over Africa south of the Sahara, below 6,000 feet, and is a notorious nest robber that feeds on chameleons as well as birds. A back-fanged species, it grows to about seven feet and has an extremely potent venom. However, like most of the dangerous snakes, it would rather run than attack humans; given half a chance, it will avoid a human and strike only in defense.

The exception to this rule is the puff adder, not particularly because of a nasty disposition but because of its modus operandi. Like the other members of its viper genus, *Bitis arietans* relies for its food on camouflage, lying in wait for its prey



The green mamba is often found sunning itself in the tops of bushes and trees, where its color makes it almost indistinguishable when motionless. Here the undulation of the snake in motion and the unnatural angle of strobe lighting make it stand out against the foliage.

beside tracks used by birds and small rodents. By the nature of its method of attack it does not move away when a human approaches, but remains completely still. It therefore gets trodden on and strikes.

Its patterned body ranges through a variety of colors from pale yellow, through olive to olive green to gray with black and white markings. Again according to James Ashe, there is a tendency for males to be yellow or yellow-olive, with the females grading from dark olive to gray-black.

Bitis arietans (the *Bitis* genus includes also the Gaboon viper, the rhinoceros viper, and the rare Kenya-horned, or Worthington's viper) has a venom that acts comparatively slowly on humans, but the actual blow as it strikes is surprisingly heavy. Like the other vipers, it strikes its normal prey, then releases it and follows it up before swallowing it. It can be found in any sort of countryside below 6,000 feet, and particularly large specimens seem to favor very hot dry areas.

Having gained first-hand knowledge of these snakes in action, the researchers concentrated on the green mamba and the anticoagulant in its venom as a promising avenue to the possible treatment of thrombosis.

An important step in the investigation involves fractionation of green mamba venom into its components in an attempt to isolate the element or elements of the venom that combat clotting, or coagulation, of the blood.

There are at least 13 known factors involved in coagulation of the blood, of which fibrin—a filamentous protein—is a key factor. A critical stage in the clotting process is the conversion of the fibrinogen, a simple protein, in the blood into fibrin. The green mamba venom must be fractionated into its components to try to isolate its anticoagulant element or combination of elements; at the same time, researchers hope to determine at what point the venom triggers the chemical activity that initiates the clotting process. The research group has come up with what seems to be the answer to a paradox that has puzzled doctors and snake experts alike.

The boomslang's venom is classed as a coagulant, causing the blood to clot. Yet one of the symptoms of the boomslang's bite is that the victim hemorrhages, with huge areas of bruising appearing under the skin—apparent evidence of anticoagulation.

Basically, what happens is that normally the blood contains fibrin, a natural coagualnt, which, when the snake bites, is used up forming the immediate clotting characteristic of the boomslang bite. But the withdrawal of the fibrin from the blood in other parts of the body results in internal bleeding because the blood there lacks its natural coagulant.

Genetic Phenomenon, the FORMOSA MOLLY

BY KLAUS D. KALLMAN

MOLLIES ARE POPULAR aquarium fishes bred by millions of people all over the world. However, very few home aquarists know that one type of molly apparently has done away with males, and therein lies our story. Mollies belong to the family Poeciliidae, which also includes platies, swordtails, mosquitofish, and guppies. In these fishes the anal fin of maturing males develops into a copulatory organ, the gonopodium, with which the sperm is transferred into the oviduct of the female. Fertilization is internal with the eggs developing inside the female for about three weeks, at which time live, free-swimming young are born. The females can store sperm for prolonged periods of time—one fertilization is sufficient for several broods. Mollies are one of the largest poeciliid fishes, growing four to five inches long and one and one-half inches in depth. They most often appear olive green, but special strains have been bred that are jet-black or mottled, while others have no trace of black pigment and are true albinos. There are also varieties with long ornamental fins. Breeding males often develop a striking orange coloration of fins and body.

Mollies are one of the most abundant fishes in Central America. They are found in pools, ditches, streams, and lakes on both the Atlantic and Pacific slopes. Some live in brackish water near the coast, others at an altitude of 6,000 feet. Some have become adapted to peculiar environments, having successfully invaded several hot springs and at least one cave. The eyes of the cavernicolous molly are either absent or greatly reduced in size and most of the black pigment cells are missing.

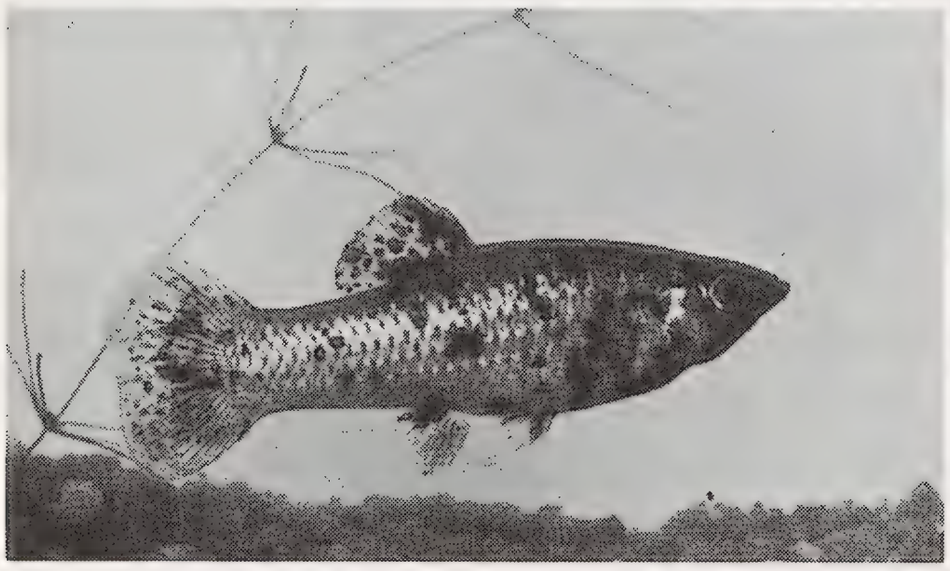
Only two species are native to the United States. The sailfin molly, *Poecilia (Mollienesia) latipinna*, lives along the coast from North Carolina southward to Key West and then along the Gulf Coast as far as Yucatan. It is deep-bodied and very appropriately named after its long flowing dorsal fin. A second species, *Poecilia formosa*, occurs in southern Texas in the Rio Grande Valley from Brownsville to Raymondville, and also farther south in Mexico. Compared to *P. latipinna*, the *formosa* molly is rather plain-looking, with a much smaller dorsal fin and more slender body. But this molly is most amazing—for all *P. formosa* are females.

This was first discovered in 1932 by Carl and Laura Hubbs, American ichthyologists. They thought that *P. formosa* must reproduce by parthenogenesis, but soon found that this was not the correct explanation. When fish were kept isolated in an aquarium they ceased to breed as soon as the supply of stored sperm became exhausted, and young virgin females never gave birth to any young at all. Even if a sailfin male was added to the tank, but separated from the *formosa* female by a clear glass plate, no offspring were produced. It was necessary for the male to provide more than a visual stimulus. Progeny were produced only after a sailfin male was mated with *P. formosa*. Such a *formosa* x *latipinna* cross yielded only female offspring that looked indistinguishable from the *formosa* parent. Similar matings between *formosa* females and males of the solid black molly stocks produced only olive-green females identical with *formosa;* and when such matings were repeated for many generations the same result was obtained over and over again. Presumably the all-female *P. formosa* maintains itself in Brownsville by mating with males of *P. latipinna*, but the sperm merely provides the stimulus for the egg to undergo development and no genetic material is transferred to the egg. This mode of reproduction is known as gynogenesis and resembles parthenogenesis in that the offspring only inherit traits from the female parent.

South of Texas, in Mexico, there is another species of molly, *P. mexicana*, which has an even shorter dorsal fin than *formosa* and a still more

Map: finely stippled — range of *Poecilia latipinna*
horizontal lines — range of *Poecilia mexicana*
large dots — range of *Poecilia formosa*
The status of *P. latipinna* and *P. mexicana* in southern Mexico and Central America is not well known.

"Sphenops" **molly of solid black variety, male.**



One of the rare triploid hybrids between a *P. formosa* **female and a jet black** *sphenops* **male.**

Poecilia latipinna, **the sailfin molly. Female in front, male behind. Note large dorsal fin.**

One of the rare "mottled" hybrids. Parts of this female are just like *formosa.* **Other areas of the body resemble the** *sphenops* **male.**

A *formosa* **female with a black scale graft from a mottled hybrid.**

slender body. This species consists of males and females and is known in the aquarium trade as the "*sphenops molly.*" In the head waters of the Rio Tamesi (Mexico) and in other streams south of the Rio Grande where *P. latipinna* does not occur, *P. formosa* breeds with *P. mexicana.* Since *P. formosa* is found roughly in an area where the ranges of *P. latipinna* and *P. mexicana* meet and since its general shape is intermediate between that of the two bisexual species, Hubbs suggested that *formosa* might be of hybrid origin. And indeed when the sailfin was bred with the *sphenops* molly, hybrids were produced that looked very much like *P. formosa.* Unfortunately, some of the hybrids turned into males; and the female hybrids, when mated, did not reproduce by gynogenesis but reproduced sexually. Thus the origin of *P. formosa* remains a mystery.

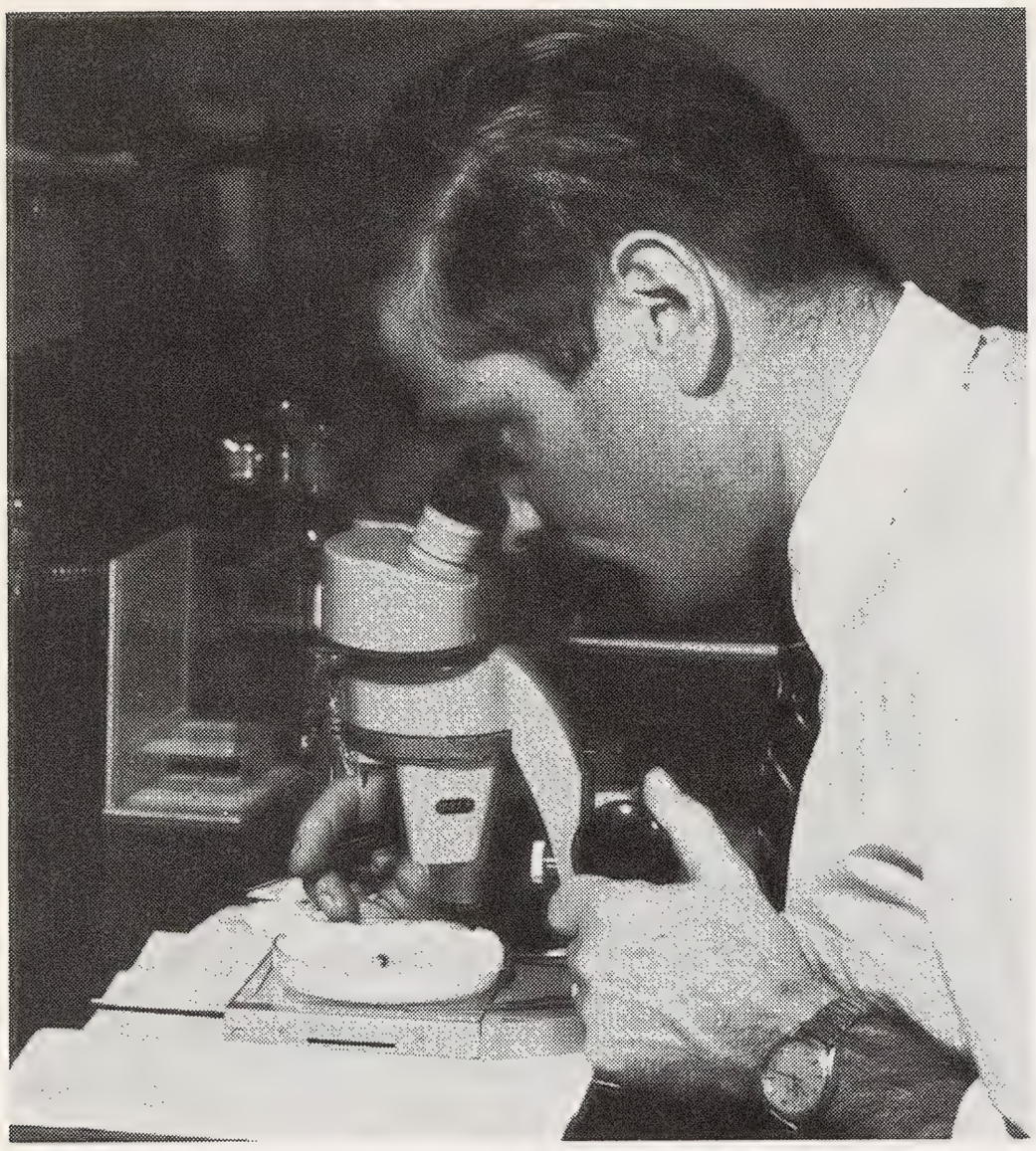
Laboratory tests have also shown that the *formosa* molly will breed readily by gynogenesis when mated to males of other species of *Poecilia* with which it would normally not come into contact. The males of *P. (Limia) nigrofasciata,* native to Haiti, and *P. (Limia) vittata* from Cuba proved just as effective as *latipinna* and *mexicana* males. Some offspring were also obtained after mating *formosa* with the guppy, *P. reticulata* and *P. parae,* species native to northern South America and Trinidad. But when males belonged to other poeciliid genera such as *Xiphophorus* (platies and swordtails), *Gambusia* (mosquitofish), or *Poeciliopsis,* no young were obtained.

I first heard of *formosa* mollies in 1957 when I was a graduate student at the genetics laboratory of the New York Zoological Society. I admittedly took a rather dim view of such an unorthodox reproductive mechanism which at that time seemed virtually unique for vertebrates. Dr. Caryl P. Haskins of the Carnegie Institution of Washington happened to visit the laboratory and mentioned that he had a colony of *formosa* mollies which he maintained by breeding them to *vittata* males. Most of the broods he raised consisted entirely of females showing no trace of paternal inheritance. But sometimes offspring were produced that were intermediate and unmistakingly exhibited patterns of the *vittata* parent. Moreover, many of these hybrid offspring were inexplicably males! I was more impressed by these male hybrids than by the many all-female broods. Did not the appearance of the "intermediate males" with paternal characters indicate that *formosa* mollies reproduced just like other animals? A good critical test for gynogenesis was needed!

Reproduction by gynogenesis has important genetic implications. Since the sperm merely supplies the stimulus for the egg to develop, but do not contribute any genes, the offspring of *formosa* females must receive all their genes and chromosomes from the female parent, while in sexual reproduction some of the genes of both parents are passed on to their young. Thus, all the progeny of a given *formosa* molly and their ancestors as well as all their descendants should possess precisely the same genes. Such a line of organisms that have identical genotypes and do not reproduce sexually is said to be a clone.

In animals including man only under exceptional conditions are two individuals identical. Perhaps the best known examples are identical twins which have developed from one fertilized egg cell. Their genetic identity is reflected in their extraordinary similarity which goes far beyond that of ordinary brothers and sisters or of fraternal twins which have arisen from different germ cells. Identical twins not only look alike, their biochemistry is also much the same. This can be demonstrated in many different ways. For example, tissue transplants exchanged among unrelated persons or between brothers and sisters are destroyed rapidly, because each individual possesses a unique set of tissue antigens which are under genetic control. This is the reason why skin grafts between identical twins survive but not between other individuals. The situation in fish is not much different.

Although gynogenetic mollies are not identical twins, they share many of their attributes. Bearing in mind that a *formosa* female has arisen from a stimulated egg to which no paternal genes have been added, it follows that it too will produce eggs all of which will have exactly the same genotype. This process must repeat itself generation after generation. I had an idea that this genetic sameness could be demonstrated dramatically by tissue transplantation. If reproduction was by gynogenesis, there would be no antigenic differences and the grafts would survive. I obtained my first *formosa* from Dr. Haskins and made fin transplants. I had the answer in eight days, but it was the wrong one! The grafts disintegrated rapidly.



The author, Dr. Klaus Kallman, examines one of his specimens in his laboratory at the Osborn Laboratories of Marine Sciences.

It occurred to me that although all *P. formosa* look alike there might be many clones. (A clone can be defined as a group of organisms of identical genotypes that have descended from a single individual). There was no assurance that my original *formosa* mollies had descended from the same female. I then proceeded to breed the fish myself keeping female parents and their broods separate. Eventually grafts were made in the following combinations:

–among siblings
–between fish of different broods but born to the same parent
–from female parent to offspring and vice versa
–between the offspring of different parents known to be unrelated
–from offspring to male parent

The results were unequivocal. In the first three combinations all transplants survived, while in the other combinations the fins disintegrated rapidly.

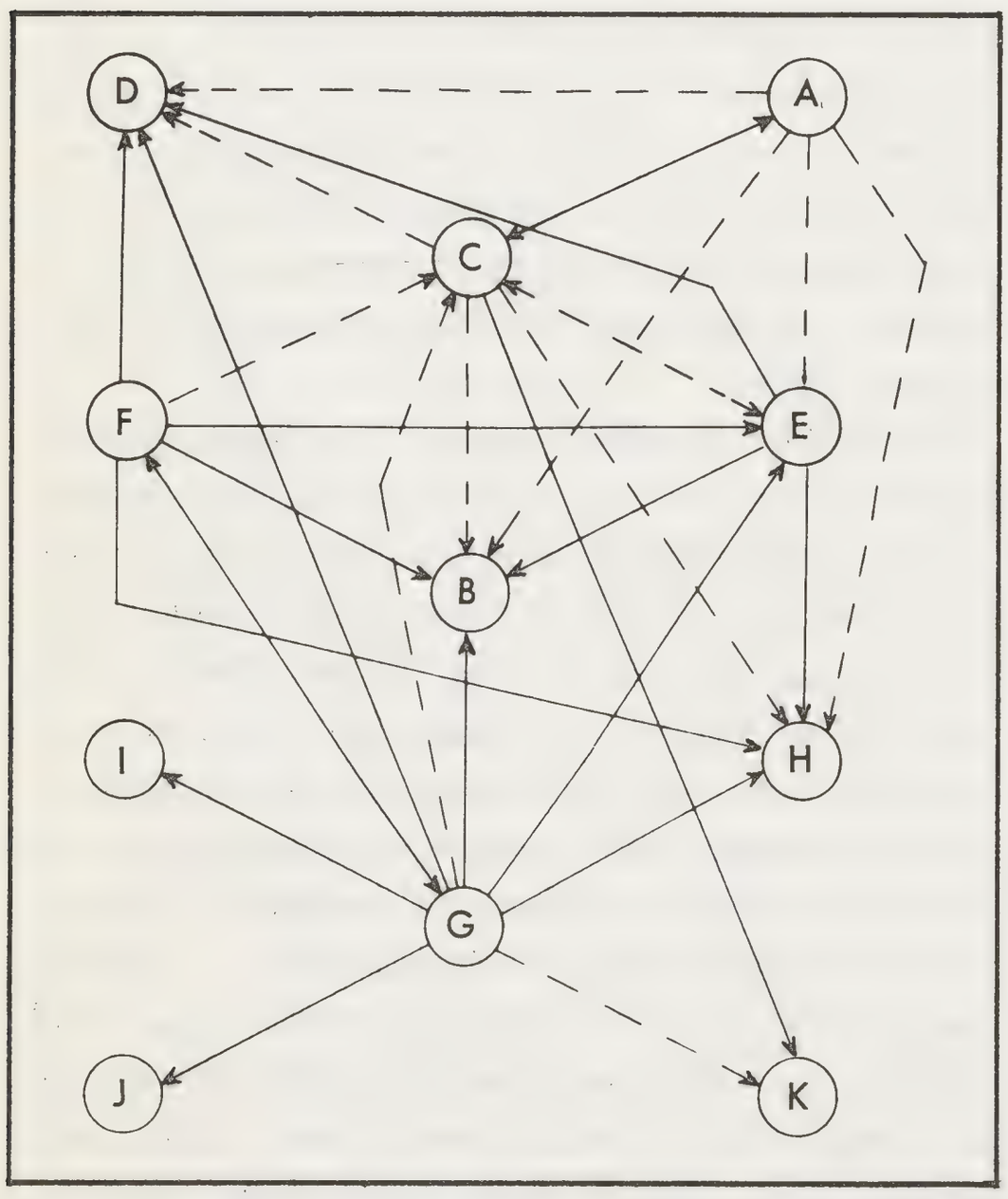
The demonstration in the laboratory of the existence of clones raised interesting questions for us. We wondered: do natural populations of clones also exist, and if so, what is their geographical distribution? Perhaps populations numbering tens of thousands of fish are composed of single clones, a situation similar to that of the futuristic society predicted by science fiction authors, in which each individual has the same "ideal" genotype. On the other extreme we might find that each clone is represented by but a single fish. And if natural clones exist, we asked ourselves, how do they arise?

The decision to collect *P. formosa* in Texas and ship them alive to New York was quickly made. However, I first had to find a suitable locality to catch the fish. Fortunately I enjoyed the close cooperation of Dr. Clark Hubbs, the son of Dr. Carl Hubbs, of the University of Texas, Austin, who was also interested in the *formosa* problem. The Rio Grande Valley near Brownsville is dish-pan-flat country crisscrossed by water courses. Most obvious are the many winding arms of the Rio Grande, locally called "resacas," through which the river emptied its water into the Gulf of Mexico before its main channel became diked. In the area's picturesque towns some resacas are now beautifully landscaped lagoons. Others are used to drain flood basins, and some are just weed-choked dead waters surrounded by cotton fields. There are also drainage ditches with steep banks, five to nine feet deep, overgrown with mesquite and prickly pear cactus. Only during rainy periods is the water in these ditches more than a foot deep. Third, there are elevated irrigation ditches, which on little aqueducts cross over both resacas and drainage channels. Heavy rains turn the entire area into one huge lake. Eventually we learned that mollies are found particularly in the weedy areas of the resacas and that vast hordes are inhabiting the drainage ditches.

Dr. Hubbs knew that in San Marcos, near Austin, a closed population of *P. formosa* had become established by the accidental introduction of 20 females in 1955. Since sailfin mollies had also been released in the San Marcos River several years earlier, *P. formosa* found the right type of male and was able to maintain itself far north of its normal range. Both species can survive in the San Marcos River because it originates from a series of large springs that maintain a constant temperature of 74°F. throughout the year and prevent the fish from becoming killed off during the winter. Having been derived from 20 individuals the San Marcos population could at best consist of 20 clones, but most likely fewer, since some fish may have died before reproducing and some of the original fish may have belonged to the same clone. On July 23, 1960, I caught 11 *P. formosa* in the San Marcos River. But since this

population was somewhat artificial, I went overnight to the Rio Grande Valley and collected on the next day 10 fish from a ditch near the Lula Sams State Fish Hatchery at Brownsville. At 10 A.M. the fish and I were already on a plane speeding back to New York. At 7 P.M. in the evening the fish were swimming in specially prepared tanks at the genetics laboratory. The first brood was born the next morning.

The next step was to exchange tissue transplants among the fish to find out which fish accepted grafts and how many clones were present in the sample. Each fish, however, represented a certain investment of time, effort, and money and we did not dare to jeopardize their survival by operating on them directly. Rather we experimented on their offspring; after all, the precise genotype of the wild-caught individuals was multiplied many times over in their descendants. Since the offspring of each of the 11 wild-caught fish from San Marcos (A to K on the accompanying diagram) could serve both as hosts and donors of tissue transplants, altogether 110 host-donor combinations were possible. Only about half of them were tried, but they were sufficient to show without doubt that the 11 San Marcos fish were of two clones. From the accompanying diagram it is apparent that A, C, and K belong to one clone (arbitrarily denoted as clone V) and the remaining eight fish to another (clone VII). All grafts within a clone were accepted, but those made between clones were destroyed in less than two weeks.



Tissue transplants among 11 *P. formosa* females (A-K) collected at San Marcos, Texas. Arrows point from graft donor to recipient. Broken arrows indicate graft is destroyed, solid arrows indicate graft survival. A, C and K form one compatible group (clone V) and B, D, E, F, G, H, I and J another (clone VII). Grafts between clones are not successful.

The 10 *P. formosa* from Brownsville were similarly analyzed and could be arranged into three clones—one consisting of six fish and a second of three fish and one molly representing the sole member of the third. We did not expect any fin grafts from San Marcos fish (clones V and VII) to survive in those from Brownsville. These transplants were made because we were interested in determining how fast fin grafts between "obviously" unrelated fish are destroyed. But to our utter amazement the transplants survived. Could it be possible that the clones of San Marcos also exist in Brownsville? We checked and rechecked our records to make sure that no fish were accidentally mixed up. But there was no doubt that clones V and VII were also present in Brownsville. It became imperative for us to establish the origin of the San Marcos fish.

Then the following story came to light. In 1953 the Texas Game and Fish Commission had a mobile exhibition of Texas fish, including *P. formosa*, touring the different counties. Near San Marcos the vehicle broke down and the fish were dumped in a nearby fish hatchery from which they soon escaped into the San Marcos River. By a mere coincidence the *formosa* mollies for the exhibition had been collected in the same ditch at the Lula Sams State Fish Hatchery as our fish taken in 1960.

Thus the transplantation experiment not only tested a sample of the Brownsville population in 1960 but one from 1953 as well. The fact that both clones V and VII were present both times indicates that the clonal structure of the population is rather stable. Since then about 250 *P. formosa* from different areas in Brownsville have been analyzed over a period of five years. Clones V and VII were always represented and often made up more than half the samples. Several other clones were repeatedly identified.

Occasionally, however, things do go wrong and some offspring of a *formosa* female inherit paternal characters. How this happens is still unclear. The incidence of the hybrids is quite low. Dr. Haskins obtained a few broods in his laboratory in which most individuals were hybrids; since 1960 we have raised several thousand *P. formosa* mollies in the genetics laboratory of which only 15 were hybrids. In body shape many are similar to *P. formosa* and were it not for the fact that they show paternal pigment patterns they would go unnoticed. The hybrids of *formosa* x *sphenops* (black variety) are of two types. Some (class A) are uniformly spotted and fin transplants from their pure *formosa* siblings survive in them. But grafts in the reciprocal combinations do not succeed. These observations show that *sphenops* tissue antigens are present in the hybrids and, therefore, fins from hybrids are rapidly destroyed by their normal *formosa* siblings. A second type of hybrid (class B) is mottled; certain parts of the body are indistinguishable from pure *P. formosa* while other areas resemble in their pigmentation the *sphenops* parent. As far as tissue transplantation is concerned, the class B hybrids behave indistinguishably from *P. formosa.* Although we do not yet know the origin of the class B hybrids, we suspect that they are mosaic individuals, the genotype of some cells just like *formosa* but other cells having one or more *sphenops* chromosomes.

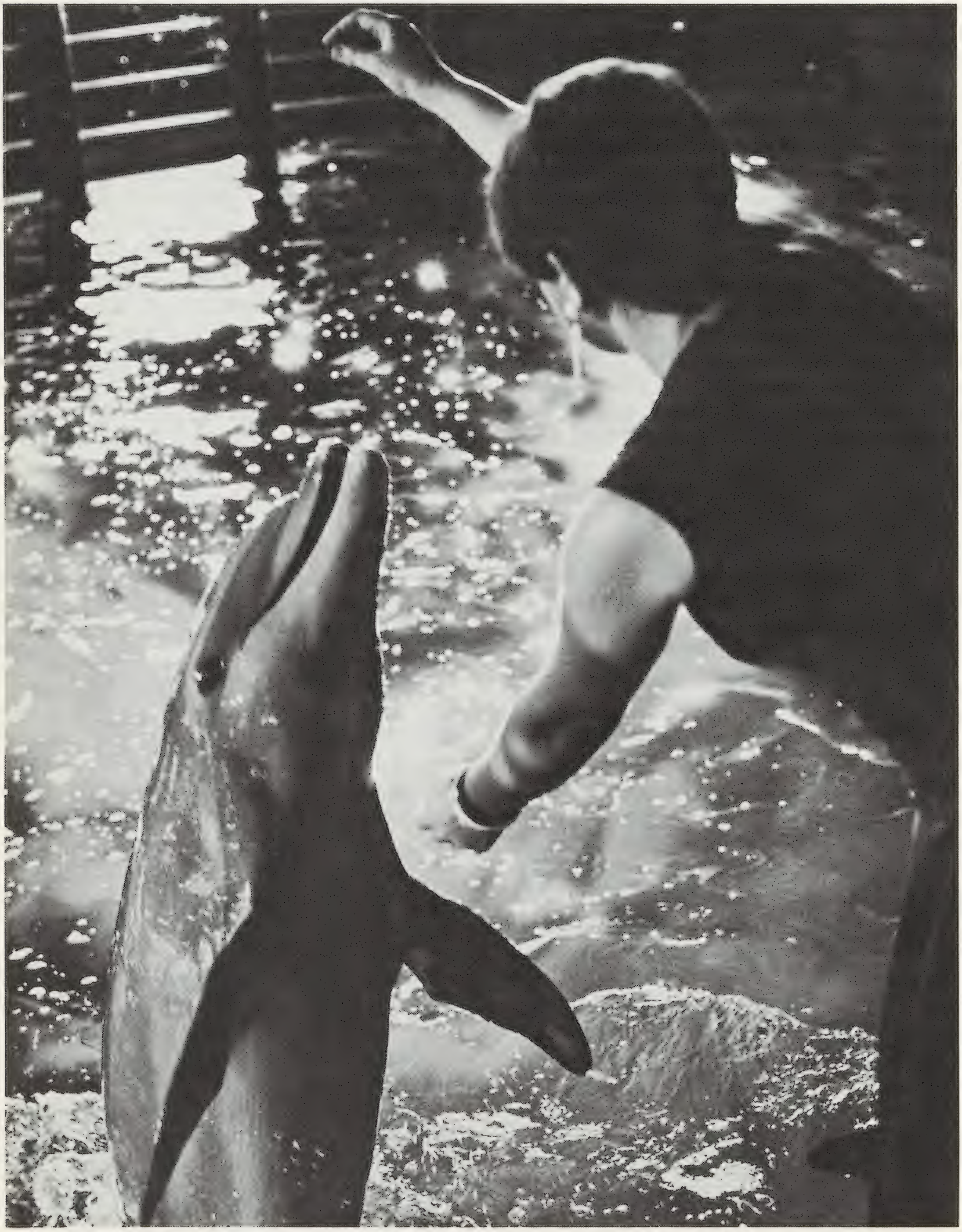
The class A hybrids are triploid (three sets of chromosomes) and seem to have originated from the fusion of an egg containing two sets of *formosa* chromosomes with a *sphenops* spermatozoon. Although the chromosomes were not counted, the triploid condition was indirectly discovered by Dr. Ellen Rash of Marquette University who measured the DNA content per cell by means of microspectrophotometry. The amount of DNA, the chemical stuff of which genes are made, per cell is specific for each species. In the cells of *P.formosa* there are 1.6 picograms (1 gram equals 1,000,000,000,000 picograms), in the *sphenops* molly 1.7 picograms, and in the cells of the hybrids 2.4 picograms which is the sum of the amount present in *P. formosa* plus half the amount present in the *sphenops* molly. Thus the hybrids are two thirds *formosa* and one third *sphenops.*

Since *P. formosa* gives rise to many more reproductive units (females) than the sailfin molly, there is the possibility that the *formosa* molly may swamp the Brownsville area and become infinitely more numerous than *latipinna.* Eventually a point would be reached where the sailfin males would encounter only *formosa* females. This would lead soon to the extinction of *latipinna* to be followed shortly by that of *formosa.* However, both species maintain the status quo. Clark Hubbs has, in fact, called *P.formosa* a sexual parasite of *P.latipinna,* but as a well-adjusted parasite we can expect it to live off its victim, not kill it.

In southern Texas both species live in quiet shallow waters and are often taken together in the same seine haul. But in brackish water only the sailfin molly is found. Thus even if it were eliminated further inland, it could maintain itself along the coast and reinvade the resacas once *formosa* had disappeared. There is, however, no evidence that either species is in danger. During my collecting trips I have often noticed that in the resacas *latipinna* was much more abundant than *formosa.* Many seine hauls yielded a high proportion of sailfins but very few *formosa.* However in the drainage ditches the situation is reversed. Thus the two species prefer slightly different habitats. Furthermore, Clark Hubbs observed in laboratory experiments that during courtship the sailfin males show a definite preference for their own females. This apparently also holds true in nature. In the spring *formosa* females do not become fertilized by sailfin males until all *latipinna* females have been inseminated. How do the males "know" that their own females are fertilized? Presumably,the sailfin females, like other poeciliids, once inseminated and gravid, no longer respond to the courtship behavior of males and may actually become aggressive to them. The males will then direct their attention toward the *formosa* females, which are still receptive. In Brownsville *P.latipinna* has also adjusted its sex ratio to maintain the balance. More than 50 per cent of the young of a sailfin brood develop into females. According to Clark Hubbs the ratio of males to females (both species) varies from 1:10 to 1:100. Because males are few in number and prefer their own females, all *latipinna* become gravid while many *formosa* do not.

As long as the eggs of *P. formosa* have to be activated by spermatozoa of related species, there is no danger that the *formosa* molly will take over.

THE MONTREAL AQUARIUM



BY ARTHUR FISHER

I STEPPED OFF the Expo Express into a swirl of sound and color. Groups of people were singing French songs. Nearby, banners strung from a rugged log palisade proclaimed a wild and woolly Western experience to be had at "Fort Edmonton." Hawkers invited passersby to try their hand at games of chance and skill, or to submit to the thrills and spills of carnival rides.

This was La Ronde, the sprawling amusement area of Expo 67, Canada's world exhibition that drew more than 50 million people during 1967. Here, with Expo, a major aquarium was opened—the Montreal Aquarium, a 4-million-dollar joint venture of the City of Montreal and the Aluminum Company of Canada, Ltd., principal subsidiary of Alcan Aluminum, Ltd. The main exhibits at the aquarium, now operated by the city, are housed in the Alcan Pavilion, adjacent to a pool where dolphin shows are presented.

Dr. Joseph Geraci, the 29-year old curator of the aquarium, had graciously agreed to show me the sights in the absence of the aquarium's director, Paul Montreuil, former director of the New York Aquarium.

First to greet the visitor on entering the pavilion is perhaps the most popular exhibit of all—a penguin colony. From outside, you circle a glass-enclosed "Penguin Island"—a realistic ice island totally surrounded by water. This means that the birds can swim continuously around their island without ever being brought up short by an unnatural barrier. It is a feature that makes this penguin exhibit unique in the world—there is no other like it. The natural-looking complex of rock and ice is made of fiberglass. Credit for the innovative design goes to Jerry M. Johnson, curator of the Department of Exhibition and Graphic Arts of the New York Zoological Society.

Both air and water temperatures inside the exhibit are kept at 50°F., a compromise selected to satisfy the varied temperature needs of a very varied group of penguins from different locales and climates. The penguins that reside at the Alcan Pavilion include king, macaroni, rockhopper, gentoo, and black-footed. They originate in climes ranging from subtropical to polar. The king penguin roams the Antarctic and may encounter temperatures of 30°F. below zero. At the other end of the range, the black-footed penguin, from the southern tip of Africa, may bask in air as warm as 70°F. The constant temperature of 50°F. was picked as one in which all these species could thrive.

For a first-hand visit to Penguin Island, I was escorted through the exhibit area. When I climbed through the trap door into the middle of their world, most of the penguins in the display took my appearance quite calmly. The large king penguins seemed the most wary, keeping a respectable distance between us and edging nervously toward the outermost border of the island as I approached. If I took one extra step—as if crossing some invisible, perhaps territorial line—they immediately dove into the water and literally swam circles around me.

Other penguins more or less ignored me. But the rockhoppers, sprightly birds whose heads are adorned with a spray of bright gold whiskerlike feathers, investigated me closely. Some stood staring up at me, as if waiting for a tasty fish tidbit. And one must have accepted me as part of the landscape, for it took up a station on my foot. Frankly, my visit caused more excitement among the human watchers outside the glass than among the penguins inside. I was laden with bulky photo equipment, and as I clambered about the slippery wet fiberglass "rocks" and reached for nonexistent handholds, I came perilously close to slipping and joining the penguins in the water. Each potential mishap was greeted with cries of delight from the crowd, and I had the feeling that if only I had toppled, camera and all, into the penguin-crowded moat, their day at Expo would have been made joyously complete

After I made my exit through the trap door, Dr. Geraci guided me up the carpeted steps rising from the pavilion's first level to the main floor. Here were bank upon bank of tanks, containing an extremely large and varied collection of fish and other marine animals. There are 27 tank systems, each tank having its own filtration and temperature control system. The tanks range in size from

350 to 20,000 imperial gallons and one is rectangular.

Here are knife fish from Africa, 350-pound groupers, and a superb Canadian collection. Fish from Nicaragua and fish from Japan—carp specially bred and presented to Expo 67 in honor of Expo 70, which will take place in Osaka, Japan. There is even a school of piranha, the small South American fish with the large, ferocious reputation. The Montreal piranhas eat nothing more blood-curdling than chopped fish.

Ascending from the main exhibit level, we came to a rotunda with what may well be one of the most spectacular aquarium exhibits in the world—the Coral Reef Room. Our entire field of view was filled with a 200-degree circular chunk of the Great Barrier Reef simulated by tanks set into the wall. Colored light played over the "reef" and its inhabitants behind the great sweep of glass. Overhead, a brilliant "Down-under" sky shone—painted on a planetariumlike dome. Some 168 principal stars of the Southern Hemisphere twinkle here. The positions of the stars and constellations were mathematically plotted with great precision so that the night sky appears here as it looked over the Great Barrier Reef of the Southern Hemisphere on April 28, 1967—the opening date of Expo 67. In the dimly lit room, with the shimmering reef before us and the stars above, the effect was breathtaking.

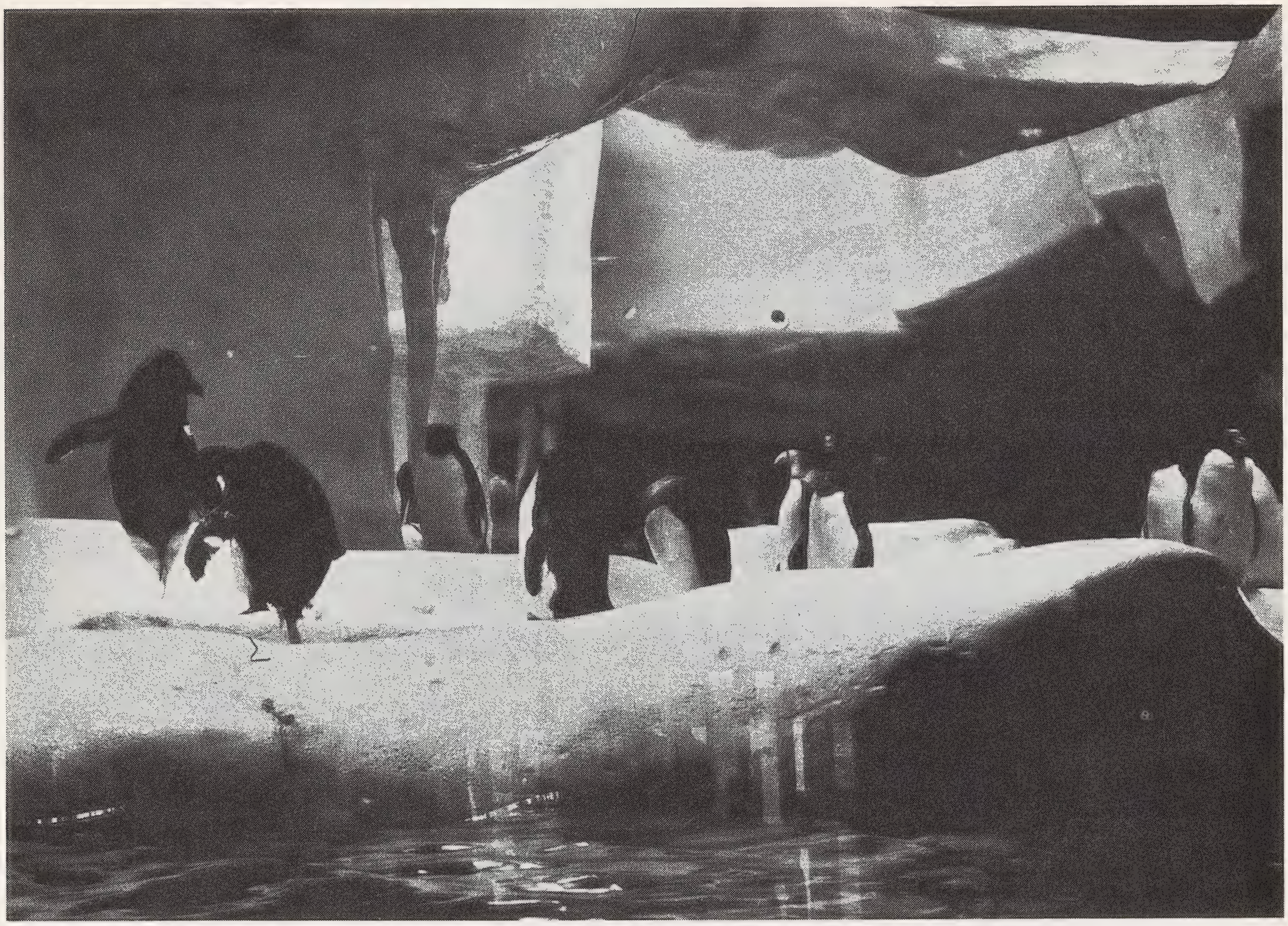
How had the idea for a coral reef exhibit come about?

"The reef best displays the most suitable environment for tropical fishes," Dr. Geraci says. "It is the most natural representation of a marine tropical environment. Besides, the most colorful fishes and invertebrates live in the reef."

The Montreal reef accommodates only tropical marine life—more than 1,000 specimens representing some 150 species—in the 20,000 gallons contained by the four tanks. They include trigger fish, groupers, and moray eels. (Sharks do not go in this exhibit because, although they are reef inhabitants, they might damage the artificial "reef" environment: Their rough skin would abrade the Plexiglas tanks and reduce visibility!) Invertebrates include the sea cucumber, a holothurian noted for its ability to turn itself inside-out and spew out its digestive organs when attacked.

Also included are some of the most dangerous denizens of the coral—fish belonging to the highly poisonous scorpion fish family, tough customers that are the bane of skin divers and others who explore the coral reef. Their spines contain a potent neurotoxin; to step on a stonefish or lionfish courts agonizing injury or even death. Handling such a fish is extremely difficult and aquarium personnel must wear heavy gloves when working with these fish, to protect themselves

The reef tank at the Montreal Aquarium simulates the Great Barrier Reef and accommodates more than 1,000 specimens.



Penguin Island at the Montreal Aquarium is made of fiberglass and encircled by water. Air and water temperatures inside the exhibit are kept at 50°F.

from possible injury.

The colorfully dramatic lighting of the tanks includes incandescent, fluorescent, and ultraviolet lighting. The ultraviolet radiation is used to provide certain specific requirements for fish, invertebrates, and algae—it simulates the ultraviolet light they would receive from the sun in nature. But it has an incidental effect, which illustrates a curious phenomenon.

Certain marine invertebrates, Dr. Geraci explained, actually emit a low level of light—*fluoresce*—when stimulated by ultraviolet light. One such invertebrate is the sea pen, a colonial animal that has a long stalk as a supporting column, to which are attached many fleshy colonies up to six feet long. Some members of the group do remind one of nothing so much as a quill pen. The aquarium is planning special, small displays in which marine fluorescence will be featured.

We left the Coral Reef Room via a huge ramp that swept down to the main floor and strolled over to the Alcan Dolphin Pool, an enclosed arena with a dramatic spiral roof. We joined an audience for a regularly scheduled dolphin show. The crowd sat in banks of seats in stadium arrangement, facing the show pool—75 feet long—and fronted by a high, protective glass wall that enabled us to see the animals' underwater antics. The audience watched happily as the agile sea mammals went through their paces—the routines that are now fairly familiar in this country.

After the show, Dr. Geraci led me beneath the arena itself to the aquarium's holding pools. He explained that of the nine bottle-nosed dolphins *(Tursiops truncatus)* at the aquarium at the time of my visit, five regularly performed in the show pool. The remaining four were being trained in the reserve area—the holding pools underground.

Expo 67 will be remembered for the spectacular picture it painted of man and his environment. But perhaps nothing at Expo so captured the wonder of life on this planet as has the great fair's child, the Montreal Aquarium.

Lee S. Crandall

60 YEARS at the BRONX ZOO

Lee S. Crandall, one of the world's best-known zoo men, recently observed the 60th anniversary of his association with the Bronx Zoo. Mr. Crandall has been the zoo's curator of birds and general curator and is now general curator emeritus. Here he reminisces about his first day at the Bronx Zoo.

"For the August *Animal Kingdom* would you please write me a 1,000-word article on your first day at the zoo? I will need it by midweek. I am sorry for the rush but... Ed."

Requests of this sort, of course, are familiar enough to all zoological park staff members. Through the years, such directives have emanated from the editors of the zoological society's publications, a line of editors that began more than a half-century ago with Elwin Sanborn. The general form has changed little from early days and "midweek" is actually a concession – "tomorrow" is the more usual term, with "yesterday" a popular alternative. Such expressions of real distress have usually evoked a sympathetic response, and Ed Ricciuti's appeal must be met in some fashion. But how does one recall the feelings and happenings of a slightly hazy day of sixty years ago?

I do know that late in the winter of 1908—at the age of 21—I visited the Bronx Zoo for the first time. I remember looking at the robins, flickers, and blue jays in the outdoor dome cage of the Large Bird House and thinking how wonderful it must be to know how to keep these beautiful things in such perfect condition, for all to see.

This feeling soon became an urge and one day that spring I found myself in the office of William T. Hornaday, first director of the New York Zoological Park. It was a large room in the southeastern section of the old Service Building, now used for the storage of supplies. But the rather dingy interior had no bearing on our meeting, for the atmosphere was dominated by the forceful personality of the short, bearded man who rose from his roller top desk to greet me and to receive a note from William White Niles, treasurer of the zoological society.

I knew that the note requested any possible consideration that Dr. Hornaday might be able to show the young man who carried it. After a brief scanning, Dr. Hornaday knew exactly what to do. He would be happy to allow me to spend the summer in the zoo as a student, working from group to group with the keepers. The only requirement was that I must learn all I could.

School closed in May and after a short vacation, I reported for duty at the zoo. Fortunately, I still have my notebooks from my first zoo experience and the opening date in Volume 1 is June 21, 1908. The Ostrich House was number one on my schedule and there I introduced myself to Keeper George Snyder. Snyder was bald, short, and corpulent, as well as good-natured and tolerant. He received me with evident pleasure, obviously anticipating the physical help I was prepared to give him in exchange for information. The arrangement couldn't have been better and Snyder and I were soon fast friends.

I had arrived just in time to help with the first duties of the morning: cutting greens, vegetables, and fruits for the various food mixtures then in use. Of all these I made careful notes and while I must say that present formulas are not always in accord, Snyder's dependents seemed to thrive. Finally, equipped with buckets and pans of food, we set forth to begin the feeding routine.

The collection then housed in the building was a motley one, everything being entirely new and fascinating to me. I was certain that I should never learn their names or know what each ate, so I set about copying labels and noting requirements, as outlined by Snyder, so that I have an authentic list. Included are frigate bird, king vulture, crested seriema, crested screamer, brush turkey, Javan peafowl, paradise cranes, Asiatic white cranes, demoiselle cranes, Sarus cranes and crowned cranes, a Ceram cassowary, emus, greater rheas, and South African ostriches. Snyder warned me, of course, to beware of the powerful kick of the cassowary and the sharp beak of the aggressive white crane. No need to tell me to give the ostriches plenty of room!

After a hasty lunch of sandwiches we both had brought from home, we set out for the Pheasant Aviary, stopping at the Wild Fowl Pond to empty a great sack of grain Snyder had carried on his back. I transported a bucket of Spratts' Patent Game Food, then the standard biscuit item, mixed with chopped greens. The ducks got only part of this delicacy, some being reserved for the pheasants. The waterfowl seemed entirely confusing to me but I later found them to include only six kinds of geese, eight species of ducks, and a pair of Bewick swans. But the mallards alone, mostly of the rather heavy local type then so numerous here, numbered in the hundreds.

The Pheasant Aviary proved to be a world of its own. It housed a really good collection of 16 kinds of pheasants, some, such as the Satchu ringneck and the Cabot tragopan, now extremely rare. Also, there were red jungle fowl, curassows, guans, chachalacas, wild guinea fowl, and plumed quail, each with special requirements as to food and treatment. Here Snyder was so completely at home that I could not possibly keep abreast.

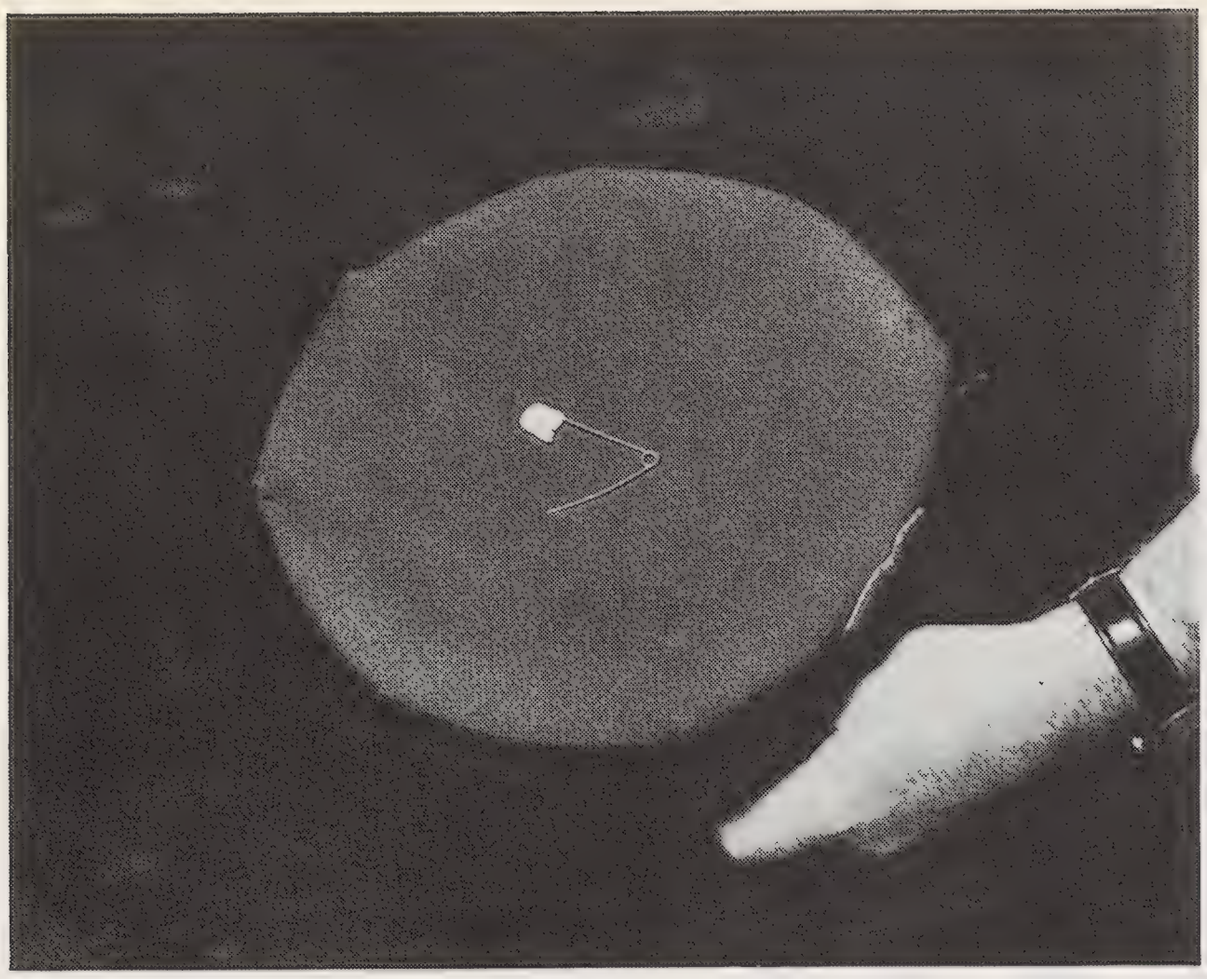
Such a confrontation, I know now, should have stunned me completely, but somehow it didn't. The urge was still there. And I had learned one thing, if no more. This course must be "learning by doing," with no *Manual*, no *Gray's Anatomy*, to serve as guide.

I had yet to meet the already famous curators, William Beebe and Raymond Ditmars, and the formidable but open-hearted Samuel Stacey, knowledgeable head keeper of birds. Of how all of them would profoundly affect my life I had, of course, not the slightest inkling but now in retrospect, to all of them I am deeply grateful.

Delicate Operation on Pachyderm

Dr. Charles Gandal (front), Bronx Zoo veterinarian, uses a forceps to remove safety pin from trunk of African elephant. Assistant Animal Manager Robert Montana (left) and Keeper Alfred Casella assist Dr. Gandal. The pin was found lodged in the elephant's trunk. The animal was drugged with the compound M-99 while the operation was performed.

Dr. Gandal applies antibiotic ointment to the wound made by the pin in the elephant's trunk.



This is the pin removed by the operation. Keepers discovered the pin after they noticed the elephant keeping its trunk in an odd position.

Photographs by Sam Dunton

Dr. Gandal administers the antidote to the drug M-99 after completion of the operation. The antidote is injected into a vein near the ear. M-99 has widespread use in zoos to drug animals while they are treated for wounds, etc. The compound is also used to immobilize animals in the wild while they are being removed from areas of extensive poaching to game reserves. (See ANIMAL KINGDOM: LXX, 4)

animal kingdom

NEWS OF ZOOS, AQUARIUMS, AND CONSERVATION

REPORTS

Six-year-old Scott Galligan of East Northport, New York, was the 150-millionth visitor to the Bronx Zoo. The new record in attendance at the zoo was set May 20. Scott was given a life membership in the New York Zoological Society.

IF YOU HAVE NEWS FOR ANIMAL KINGDOM REPORTS

send it to: The Editor, ANIMAL KINGDOM, the Zoological Park, Bronx, New York 10460. Copy should be typewritten and double spaced.

River Study

A DePauw University (Indiana) zoologist is investigating the effects on river life of hot water released by an electric generating plant.

Dr. James Gammon released initial findings of his research in a 56-page progress report recently made public. The report concentrates on a study made last summer at a generating plant north of Terre Haute, Ind., on the Wabash River. The station's operator, Public Service Indiana, provided a grant for the project, which is continuing this summer in another site.

Gammon's key finding so far seems to be this: Hot water flushed into the river by the plant has no serious effects on fish there. When the water gets too hot (about 93°F.) the fish leave the area. They return as it cools. It is not clear, according to Dr. Gammon, whether an unusually cool summer and resultant cooler river temperatures prejudiced his findings.

On the other hand, the report showed that industrial effluent could kill fish. On one occasion Dr. Gammon and his team found fish being killed by a routine industrial cleaning process that discharged an acid solution into the river.

A third finding, though tentative pending further study, was that immature macro-invertebrates (blood worms, caddisfly, mayfly, dragonfly, and stonefly) were largely absent in the hot water area. They returned to their normal distribution pattern one and a half miles down-stream. Clams, mollusks and other larger invertebrates were not studied because their preferred habitat was lacking in the study area, Dr. Gammon said.

The river water is drawn into the plant to cool condensers. It is later channeled back to the river, considerably warmer than it was when it was taken in. It is this heated water (thermal effluent) whose effects are under scrutiny.

So far only scattered studies exist on thermal effects. Dr. Gammon hopes his effort, which continues this summer near Cayuga, Ind., will be an important contribution to several new ones now underway.

Wildlife Appropriation

Senator Karl Mundt, R-S.D., reporting on approval of a $750,000 appropriation for endangered wildlife species activities, has asserted that the funds, "though not sufficient for the programs in mind," will provide a "most helpful contribution to the effort to preserve from extinction certain species of North American wildlife."

The Senator is ranking Republican on the Senate Appropriations subcommittee dealing with Interior Department appropriations. He was sponsor of the funding proposals which established at the Patuxent Wildlife Research Center the Endangered Wildlife Species research facility.

The Department of Interior appropriations bill as sent to the President contains $375,000 for acquisition of lands for the Endangered Species facility at Patuxent in Prince Georges County, Maryland, and $375,000 for land acquisition for preservation of Mason Neck wildlife sanctuary located in Fairfax County, Virginia, near Gunston Hall.

Senator Mundt said the Bureau of Sports Fisheries and Wildlife had requested in its 1969 fiscal year budget $750,000 for each of the projects which he said "are vital to both the research work on endangered species and either preservation or development of habitat conducive to protection and enhancement of these particular forms of wildlife.

"In reviewing the subsequent actions of the respective appropriations committees of the House and Senate and the end result of a reduction of approximately 10% in overall funding from the recommendations in the department budget estimates and considerably greater reductions in or complete deferrals of new programming, I think we were fortunate in achieving a compromise solution which provided each of these important projects half of the amounts requested," Senator Mundt said.

He said the Patuxent funds will permit the bureau to commence acquisition toward completion of the endangered species station. The proposed addition includes about 470 acres and it is anticipated the $375,000 will permit purchase of an initial amount of the land adjacent to the present research area.

Senator Mundt said the Mason Neck preservation program involves proposed acquisition by the bureau of 950 acres of an area which is a sanctuary for the southern bald eagle, threatened with extinction along the entire eastern seaboard.

A reticulated python—one of 21 hatched at the Bronx Zoo this spring—emerges from its egg. Hatching of the pythons was a first for this snake in the United States.

Recticulated Pythons—a First

Twenty-two young reticulated pythons, first of their kind hatched from zoo-bred animals in the United States, are doing well at the Bronx Zoo. The pythons were hatched in early May from a clutch of 51 eggs produced in February. One of the hatchlings was lost.

At birth, the young pythons averaged about 70 centimeters in length and weighed about 130 grams each.

Ralph Harris, a foreman at the Oklahoma City Zoo, holds the zoo's new snow leopard cubs for the photographer.

Snow Leopard Cubs at Oklahoma City

The Oklahoma City Zoo has a pair of new snow leopard cubs, born to "Tanya," one of the zoo's females. The cubs were sired by "Bowser II" at the Bronx Zoo, New York City.

Tanya was sent to the Bronx Zoo in February and was returned to Oklahoma City in late spring. The cubs were born in June. Last year she gave birth to two cubs, which were also sired by Bowser II.

Tanya has given birth to a total of six cubs. Wild caught, she was brought to Oklahoma City in 1965. Bowser II has sired eight progeny. He was born in 1961 in the Copenhagen Zoological Garden and came to the Bronx Zoo the following year.

As part of the continuing effort to breed the snow leopard, a female from the Milwaukee County Zoological Park is now with Bowser II at the Bronx Zoo.

New Monorail

A monorail system is near completion at the Philadelphia Zoological Garden.

When fully completed the monorail will make it possible for visitors to take an aerial tour of the zoo in open-sided, roofed cars. The cars will travel atop the rail at an average height of 15 feet above ground. The 15-minute ride will cover more than a mile of track.

The zoo plans two stations, one each at the zoo's north and south gates. The ride will begin at the north gate. Throughout the tour, riders will be able to listen to a tape recording synchronized to describe various zoo features as the cars pass them. Usually each train will have six cars, each with a capacity to seat 10 adults.

Young black rhino is on exhibit with its mother at the Oklahoma City Zoo.

Copyright 1968, The Oklahoma Publishing Co.

From the Oklahoma City Times

Black Rhino Born

A young black rhino, born of zoo-bred parents at the Oklahoma City Zoo in May, is now on exhibit there in the zoo's pachyderm building.

The calf, a female, is in an enclosure with its mother. The male parent is on exhibit within the building. Both adults were born in zoos in this country.

THE bookshelf

PENGUINS. By John Sparks and Tony Soper. 263 pp., 33 photographs, 24 text illustrations by Robert Gillmor. Taplinger Publishing Company, New York, 1967. $8.95.

It is not easy to explain human fascination for penguins. Certainly their upright posture and tuxedoed plumage help make them popular exhibits in zoological collections. In my experience I find that both scientist and layman are very interested in not only the postures and gait of penguins but their entire natural history including fine details about penguin adaptations to a unique way of life. Any book written on this subject should find many readers especially when it is done as nicely as in *Penguins* by John Sparks and Tony Soper.

A wide variety of sources, both old and new, has been used by the authors to present a well balanced picture of penguins as specialized birds which have provided men with food, profit, a challenge for scientific research and, of course, enjoyment. Penguin morphology, physiology, ecology, and behavior are discussed in easily understood language for penguins as a group and for individual species. The illustrations by Robert Gillmor make a special contribution in supporting the text about displays and structure. Chapters dealing with the discovery and exploitation of penguins were particularly interesting.

Penguins is an excellent popular book about a popular group of birds. There are a few errors in this book but they are indeed minor in comparison to its overall accuracy.

R. L. Penney

WORLD OF THE GREAT WHITE HERON. By Marjory Bartlett Sanger. i-x, 147 pp. The Devin-Adair Co., New York, 1967. $10.00.

The road from Miami to Key West, Florida, is nonstop for 150 miles, but anyone interested in the animals and plants of the area would have to pause many times to examine the world surrounding this road, the world of the great white heron. This book provides a whole spring day in which to stop and observe a great white heron as it fishes, naps, and watches all that goes on around it. Marjory Bartlett Sanger tells about the many creatures who live together in this area stretching from the Everglades to the Gulf Stream. Although birds are her special interest, she does not neglect the fishes, reptiles, mammals, insects, or crustaceans.

In her wish to touch on the many and varied roles each organism plays in this ecological complex, as well as the constant interaction of the different species, the author briefly discusses one after another, and dwells at length on almost none. On occasion the story line is lost in the rush to yet another animal.

As sometimes happens in accounts which attempt to popularize a complex subject, there are a number of incorrect or misleading statements in the book. That the green anole lizard inflates its throat like a balloon (p. 11); that the Gulf Stream is so intensely blue that its outlines can be discerned (p. 38); that dinoflagellates are considered the earliest life forms (p. 43); that no one knows how deep in the ocean depths life is sustained (p. 43); that cowfish and trunkfish have an external skeleton instead of an internal one (p. 55); that the Portuguese man-of-war are the only animals known to produce carbon monoxide (p. 58); and that *Hyla septentrionalis* came to Key West as a stowaway on a log (p. 129) are but a few examples.

Interspersed among the stories about the nature of the area is the history of the people of the Florida keys — the Indians, the Spanish, the plume hunters, and the railroad men — and the effects they have had on the area including the havoc caused by the Army Corps of Engineers. It is in this historical account that the author's best writing occurs. The story is interesting, and it flows smoothly. It is obvious that Marjory Sanger has spent a great deal of time in the Keys as she writes with an appreciation of all their facets.

The line drawings by John Henry Dick are generally excellent, and their reproduction is good. The sole exception is a "loggerhead" turtle (p. 106) so poorly illustrated it is appar-

ent the artist had no subject material from which to draw.

The book is a good guide for persons interested in this section of Florida.

F. Wayne King

THE FISHES. By Url Lanham. 116 pp. (paperback). Columbia University Press, New York and London, 1967. $2.25.

This book is readable, certainly, but somewhat light on details for those with more than a casual interest in the biology and history of the fishes. Offered in its second printing, *The Fishes* comes with 24 plates in black-and-white.

E. R.

THE WORLD OF THE FROG AND TOAD. By George Porter. 153 pp. J. B. Lippincott Company, Philadelphia, 1967. $4.95.

This is a charming and entertaining book, recommended for those with an interest in amphibians. The book is chock full of Porter's top-notch photographs of frogs, toads, and some of their neighbors. Many of these photographs are quite engaging, some are vivid studies in amphibian behavior.

The author, who grew up in Austria's rural countryside, has been a student of American frogs and toads since he arrived in this country three decades ago. He is now controller and assistant secretary of the National Audubon Society.

E. R.

THE WORLD OF THE ANT. Text and photographs by David F. Costello. J. B. Lippincott Company, Philadelphia and New York, 1968. $5.95.

This is another in the charming series of Living World Books edited by John K. Terres. It is up to the fine standards of this series, with lively, informative, and clear text, and excellent photographs. The author is a Midwesterner with a Ph.D. in plant ecology and is a veteran of 30 years' research for the United States Forest Service. Possibly the only major criticism that can be leveled at this book is that it is a bit too localized in the Pacific Northwest – but that is not nearly enough of a flaw to mar the book's high quality.

E. R.

PROCESS AND PATTERN IN EVOLUTION. By Terrell H. Hamilton. x + 118 pp., 10 tables, 56 text figures. Current Concepts in Biology Series, Macmillan Company, New York, 1967. Paperback, $1.95.

In keeping with the format of the "Current Concepts in Biology Series" this is a short introductory account of evolutionary process and principles. After a summary of the Darwin-Wallace concept of evolution, the author discusses briefly the source and nature of individual genetic variations, population genetics, population ecology, natural selection and species abundance, selection pressures, adaptation, origins of species, competition, and adaptive radiation. The text is clearly written and the author documents his discussions with numerous well-chosen published studies. Aside from the brevity dictated by the series, the greatest shortcomings of the book are the author's insistence that spatial isolation is a prerequisite for speciation in animals, and his refusal to discuss the possibility of behavioral or ecological isolation.

The illustrations are excellent and the bibliography good.

F. Wayne King

ABOUT THE authors

Sam Dunton is a staff photographer at the Bronx Zoo. **Arthur Fisher** is a science editor prominent in educational publishing. **Dr. Klaus Kallman** is a geneticist with the Osborn Laboratories of Marine Sciences. **Dr. F. Wayne King** is the Bronx Zoo's curator of herpetology. **N. J. Russell** is a journalist based in Africa.

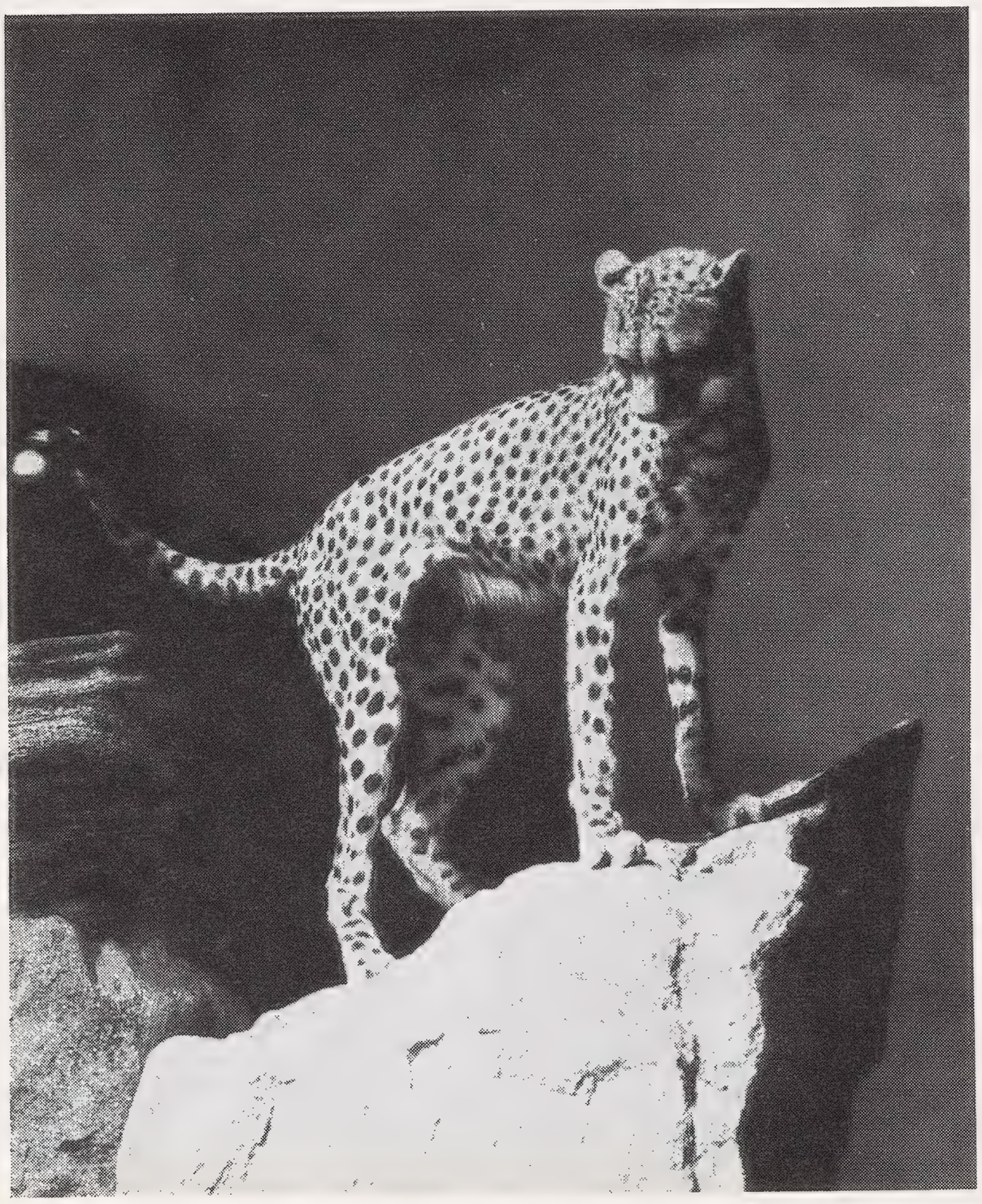
ILLUSTRATION CREDITS

Cover – N.Y.Z.S., F. Wayne King; pp. 3-7 – N.Y.Z.S., F. Wayne King; pp. 8-9 – Hilmi Oesman; pp. 10, 12 – N. J. Russell; pp. 13-15, 17-18 – N.Y.Z.S.; pp. 20, 22-23 – Arthur Fisher; pp. 26-27 – N.Y.Z.S., Sam Dunton; p. 28 – N.Y.Z.S.; p.29 – N.Y.Z.S., William Meng; p. 30 – Oklahoma City Zoo, Oklahoma City Times; Back Cover – N.Y.Z.S., William Meng.

Design by B. J. Johnson

sorry . . .

If you've missed the last six issues of ANIMAL KINGDOM then you've missed:



STEWART L. UDALL,
United States Secretary of the Interior, on "Wildlife Fights for Survival."

ALISON JOLLY,
biologist and author, on "The Wreck of the Torrey Canyon —Epilogue."

ALEXANDER F. SKUTCH,
Costa Rica-based ornithologist, on "Cotingas."

RAYMOND L. PAWLEY,
general curator at Brookfield Zoo, on "Mixing It Up in Brookfield's Reptile House."

REAY H.N. SMITHERS,
Rhodesia's director of museums, on "Cat of the Pharaohs."

and more than two dozen other articles of equal import.

START READING ANIMAL KINGDOM NOW AND YOU'LL READ:

GEORGE SCHALLER on the cheetah.

CARL KOFORD on the macaques of Japan.

WILLIAM G. CONWAY on European zoos.

DAVID HANCOCK on the peregrine.

GERALD S. LENTZ on the Oklahoma City Zoo.

and many, many more articles presenting IN-DEPTH coverage of zoos, aquariums, and conservation.

NO OTHER ENGLISH LANGUAGE ZOO-AQUARIUM MAGAZINE PROVIDES YOU WITH SUCH COMPREHENSIVE AND AUTHORITATIVE ARTICLES—ANIMAL KINGDOM

available at special rates to zoos and aquariums. Write: Animal Kingdom,
New York Zoological Park, Bronx, New York 10460

590.673
A54

animal kingdom

VOL. LX, NO. 5, OCT., 1968

NEW YORK ZOOLOGICAL SOCIETY
630 Fifth Avenue, New York, N. Y. 10020

Fairfield Osborn
President

Laurance S. Rockefeller
First Vice-President

Robert G. Goelet
Vice-President and Chairman of the Executive Committee

Henry Clay Frick, II
Vice-President

John Pierrepont
Treasurer

Howard Phipps, Jr.
Secretary

Eben W. Pyne
Assistant Treasurer

Harold C. Palmer
Assistant Secretary

BOARD OF TRUSTEES
(Executive Committee)*
Alexander Aldrich, George F. Baker, Jr.*, Robert E. Blum, Guy F. Cary, William R. Coe, C. Suydam Cutting, John Elliott, Charles W. Engelhard, Henry Clay Frick, II*, Robert I. Gannon, Peter R. Gimbel*, Robert G. Goelet*, Peter Grimm, John N. Irwin, II*, Warren Kinney, Anthony D. Marshall, Otto Marx, Jr., David Hunter McAlpin*, Peter Matthiessen, G. W. Merck, Charles W. Nichols, Jr.*, Fairfield Osborn*, Augustus G. Paine, II, Howard Phipps, Jr.*, John H. Phipps, John Pierrepont*, Eben W. Pyne, Laurance S. Rockefeller*, David T. Schiff, John M. Schiff, Henry Sears, Chauncey Stillman, Joseph A. Thomas, Landon K. Thorne, Jr., Alfred G. Vanderbilt, Robert Winthrop

Ex-Officio:
The Mayor of the City of New York
Hon. John V. Lindsay

Administrator of Recreation and Cultural Affairs
August Heckscher*

General Director
William G. Conway

ZOOLOGICAL PARK
William G. Conway, *Director & Curator, Ornithology;* Charles P. Gandal, *Veterinarian;* Hugh B. House, *Curator & Chairman, Mammalogy;* Grace Davall, *Assistant Curator, Mammals & Birds;* James C. Doherty, *Mammalogist;* Joseph Bell, *Associate Curator, Ornithology;* Donald F. Bruning, *Ornithologist;* F. Wayne King, *Curator, Herpetology;* Herbert J. Knobloch, *Curator, Education;* Charles B. Driscoll, *Superintendent, Operations;* Edward Kearney, *Manager, Facilities Dept.;* Joseph A. Davis, Jr., *Scientific Assistant to the Director;* Lee S. Crandall, *Zoological Park Consultant & General Curator Emeritus;* William Bridges, *Curator of Publications Emeritus;* Roland Lindemann, *Consultant, Mammal Management;* John M. Budinger, *Consultant, Pathology;* Ben Sheffy, *Consultant, Nutrition*

AQUARIUM
Ross F. Nigrelli, *Director;* Nixon Griffis, *Administrative Assistant to the Director;* Robert A. Morris, *Curator;* U. Erich Friese, *Assistant Curator;* Lars Mellkvist, *Superintendent;* Jewell Bungay, *Business Manager;* Louis Mowbray, *Research Associate, Field Biology;* Christopher W. Coates, *Director Emeritus*

OSBORN LABORATORIES OF MARINE SCIENCES
Ross F. Nigrelli, *Director;* Martin F. Stempien, Jr., *Assistant to the Director;* George D. Ruggieri, S.J., *Coordinator of Research;* William Antopol, C. M. Breder, Jr., Jack T. Cecil, Harry A. Charipper, Kenneth Gold, Myron Jacobs, Klaus Kallman, Vincent Liguori, John J. A. McLaughlin, Martin P. Schreibman, Eva K. Hawkins

INSTITUTE FOR RESEARCH IN ANIMAL BEHAVIOR
(Operated jointly by the Society & Rockefeller University)
Donald R. Griffin, *Director;* Peter R. Marler, Jocelyn Crane, Roger S. Payne, Richard L. Penney, Fernando Nottebohm, George Schaller, Thomas T. Struhsaker, C. Alan Lill

WILLIAM BEEBE TROPICAL RESEARCH STATION
O. Marcus Buchanan, *Resident Director*

GENERAL
Walter Lerchenfeld, *Comptroller;* Bernard M. Fagan, *Accounting Manager;* John McKew, *Personnel Manager & Assistant to the Director, Zoological Park;* Gordon Cuyler, *Membership Chairman & Administrative Associate;* Jerry M. Johnson, *Curator, Department of Exhibition and Graphic Arts;* Edward R. Ricciuti, *Editor & Curator, Publications and Public Relations;* Joan Van Haasteren, *Editorial Assistant;* Dorothy Reville, *Photo Librarian;* Sam Dunton, *Photographer*

AFFILIATE
Jackson Hole Biological Research Station
L. Floyd Clarke, *Director*

ANIMAL KINGDOM STAFF
Edward R. Ricciuti Editor and Curator, Publications and Public Relations
Joan Van Haasteren Editorial Assistant
Jerry M. Johnson Curator of Exhibition and Graphic Arts
Barbara Lee Syvertson Graphic Designer
Dorothy Reville Photo Librarian
Sam Dunton Photographer
William Meng Photographer

animal kingdom

MAGAZINE OF THE NEW YORK ZOOLOGICAL SOCIETY VOL. LXXI NO. 5 OCTOBER, 1968

ABOUT THE COVER

Front: Tufted puffin. This sea bird is but one of the interesting avian inhabitants of the rocky islands off the northwest coast of North America. David Hancock, a Canadian biologist who knows the sea bird islands well, describes these havens for bird life in the article on page 8.

Back: African bush elephants *(Loxodonta africana)* in the area of Lake Amboseli.

CONTENTS

RIVER OTTERS, SEA OTTERS, AND PART-TIME OTTERS 2
by Joseph A. Davis, Jr.

BRITISH COLUMBIA'S SEA BIRD ISLANDS 8
by David Hancock

ZOO PORTRAITS 14
Photographs by Paul G. Kovac

ROUNDUP ON THE BISON RANGE 18
by Stan Federman

T'O 24
by Peter Brazaitis

ANIMAL KINGDOM REPORTS 28

THE BOOKSHELF 31

ABOUT THE AUTHORS 32

ILLUSTRATION CREDITS 32

ANIMAL KINGDOM purchases first North American serial rights for articles, photographs and drawings. Payment is made on articles accepted for publication subject to editing and revision when necessary. ANIMAL KINGDOM is not responsible for the return of unsolicited material.

Issued bi-monthly by the New York Zoological Society at the Zoological Park, Bronx, N. Y. 10460. Editorial and Subscription Offices at the same address. Title registered with the U. S. Patent Office. Subscription, $3.50 a year; single copy, 60 cents. Same rates for all foreign countries and Canada. Second-class postage paid at Bronx, N. Y. Send Form 3579 to Bronx, N. Y. 10460.

©1968 New York Zoological Society. All rights reserved.

Printed in U.S.A.
by Clark & Fritts, Inc.

RIVER OTTERS, SEA OTTERS, AND PART-TIME OTTERS

A young Eurasian otter displays that species' typical flattened head and undershot jaw.

THIS IS THE FIRST OF A TWO-PART SERIES
BY JOSEPH A. DAVIS, JR.

THE MAMMALS as a group have been reluctant to exploit the waters from which their cold-blooded ancestors were spawned. The whales and Sirenia have become aquatic again with a vengeance and the seals have made a good try, to the point where they are more at home afloat than on land; but the number of truly amphibious mammals in other families and orders is limited to the platypus, one opossum, a handful of rodents (that order has experimented with virtually every ecological niche, it seems), a few insectivores and ungulates, the polar bear, and one member of the civet family in a remote pocket of the Far East. And then, of course, there are those extroverts of the weasel family, the otters.

This latter family, the Mustelidae, has been the most opportunistic one in the order Carnivora, giving rise to species that fill the most diverse of habitats, from desert to treetop to the coastal waters of the ocean. The otter-civet's family, the Viverridae, parallels and, in the Old World, rivals the Mustelidae. It has produced several dilettantes where water is concerned, mostly marsh-frequenting mongooses, but only the one truly amphibious species, which might best be described as a valiant attempt at producing an otter. Less than three feet long, with no more webbing on the paws than terrestrial civets have, the otter-civet does have an ottery head, characterized by a heavy fleshy muzzle, and nostrils and ears that can be closed when the animal submerges. It seems likely that the otter-civet evolved in Southeast Asia at a time when no true otter was there, for its range is restricted, and if numbers mean anything, it has been playing second fiddle to the true otters ever since their arrival.

So successfully have otters filled the niche of freshwater predators that their very presence has probably been a deterrent to the evolution of potential aquatic predatory competitors.

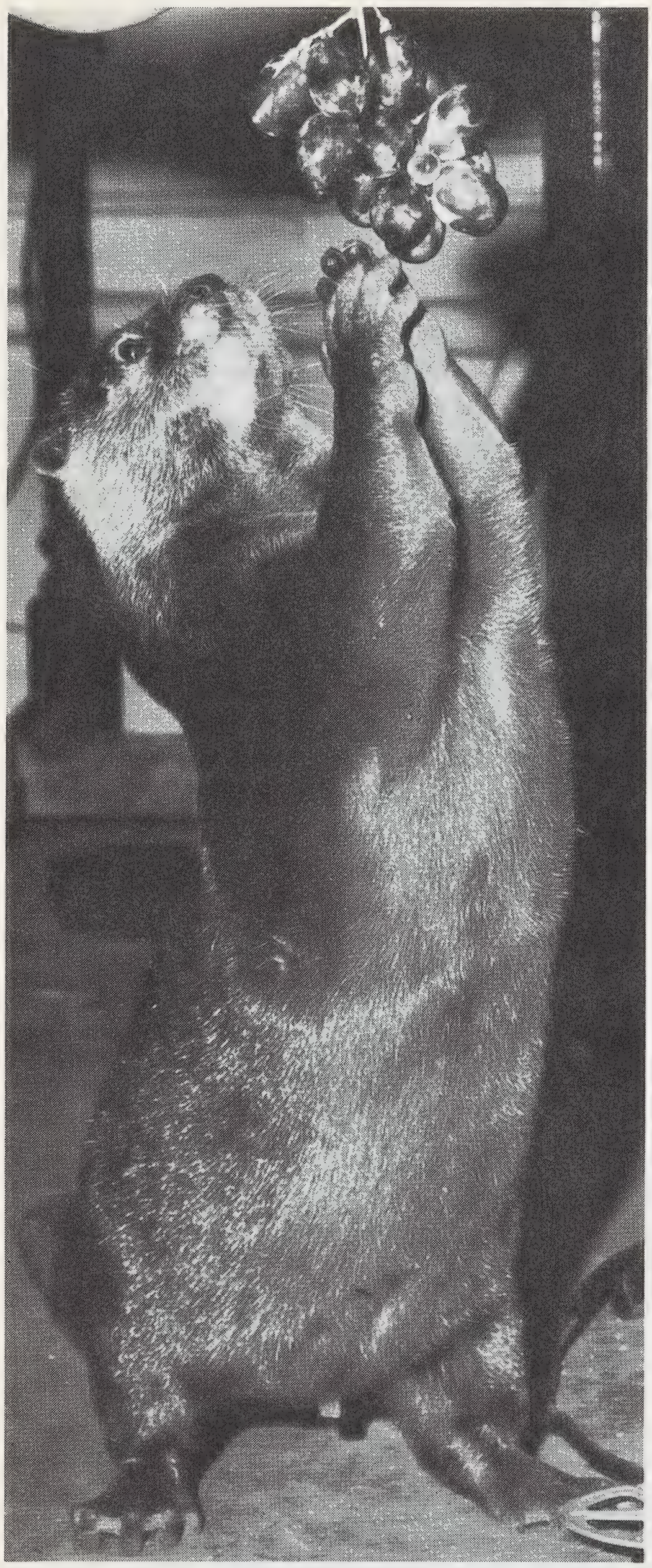
One or another species of otter hunts the fresh waters of every great land mass this side of the polar regions except Australia, and two species have moved into the Pacific Ocean—one along the coasts of North America and Asia, the other far more recently (in geological terms) off the western shores of South America.

To most persons "the otter" is one of only two kinds; an American thinks of the North American, or Canada, otter, *Lutra canadensis*, more familiar through books and movies than by sight, while an Englishman or European visualizes the Eurasian species, *Lutra lutra*, a slightly smaller animal with a narrower and flatter head. Less well known are the giant otter of South America, said to exceed six feet in total length; the Asian small-clawed otter, rarely even three feet long; the much larger African clawless otter and its compatriot, the spot-necked otter; as well as the smooth otter of Asia and the Middle East; and the sea otter. South America is also the home of five named species of river otter, but studies going on now suggest that these last are really only one species of great geographical variability and probably not specifically distinct from our North American otter.

The world's otters fall into three broad groups if viewed from the standpoint of ecological similarity. These similarities do not reflect phylogenetic relationships — immediate common ancestry — but have misled taxonomists at times to think they do.

The first group (for want of a better term they can be called the "typical" otters) is made up of the widespread members of the genus *Lutra*, and of the spot-necked otter, giant otter, and smooth otter. All of them are characterized by elongated sinuous bodies, long tapered tails, and paws that are strongly webbed. All dine extensively on fish, although not to the extent popularly supposed. The spot-neck may be exclusively a fish eater, but most otters are catholic in their eating habits, taking frogs, crustaceans and other invertebrates, and an occasional terrestrial vertebrate. Not enough is known about the last-mentioned three otter species, but all *Lutra* otters are definitely generalized in their feeding proclivities. All the "typical" otters are essentially freshwater animals except for the small marine otter, *Lutra felina*, South America's ersatz "sea" otter.

The second group are "part-time" otters, the small-clawed and clawless otters of the genus *Aonyx*. Even the clawless otters have some rudimentary claws, and the German term "Finger-otter" is an appropriate one for them. They are otters in every sense of the word except that they have specialized to fill an ecological niche that was vacant in the Old World, the niche occupied in the Americas by raccoons. (The presence of raccoons



A small-clawed otter tends to use its paws for grasping objects; most other species use the mouth.

may be the reason why no clawless-type otter ever developed in the New World.) The "part-time" otters, like the raccoons, have lost the lithe configuration of their closest relatives, growing portly in build. They have developed a fine tactile sensitivity in the forepaws, so much so that some of their basic behavior has diverged from typical otter patterns, or more accurately, patterns of minor importance in typical otters have assumed such importance in *Aonyx* that they seem to be different. The webbing, particularly of the forepaws, has become reduced to allow greater freedom of finger movement, and like raccoons *Aonyx* otters seem endlessly obsessed with an urge to manipulate small objects. Also like raccoons, in captivity they exhibit "washing" behavior, which isn't really washing at all. Although *Aonyx* otters swim competently, available evidence indicates that in the wild, crustaceans and other littoral invertebrates are their main fare; this is the kind of prey whose capture requires manual dexterity rather than swimming speed.

The third division has as its only constituent the sea otter of the northern Pacific. This species seems at first glance to be far removed from the main body of otterdom, and at one time its own subfamily was proposed to separate it from the other species.

It *is* different. It is a marine creature and un-otterlike in small ways. Heavy bodied, with proportionately much the shortest tail of any otter, its hind feet are so enlarged that they look more like seal flippers than otter feet, and according to some reports are ill-suited for terrestrial locomotion. The sea otter's forepaws look as if the fingers had been amputated, mere stumps encased in a common skin. Sea otters spend much, if not most, of their waking and sleeping hours in the water, floating in what might seem to be an unnatural belly-up position. Most curious of all, they bring stones up from the ocean floor, set them on their chests, and use them as anvils against which to hammer open the shellfish that are a dietary staple. A sea otter in the Woodland Park Zoo, Seattle, reversing the normal procedure, amused itself by hammering an anvil stone against the concrete walls of its pool, doing considerable damage to them. Finally, the sea otter has a loose, pocket-like fold of skin near its armpits and has been seen to carry its anvil stone in this place for short periods.

These are the major kinds of otter. To understand how they fit into the scheme of things and why there can be more than a single kind of otter in some parts of the world, it is necessary to begin by taking a closer look at a "typical" otter.

The trouble is that the "typical" otters are not

a natural zoological group, but rather an assemblage of comparatively unrelated species, all of which happen to make their fairly effortless living in the same way and have therefore come to resemble one another outwardly. (If you should decide to read further about them in other places, though, you will find all but the giant otter listed under the genus *Lutra* by most writers.) At any rate, we must now look more closely at some of these species.

For the past seven years it has been my good fortune (there are black hours when it seems more like the wrath of the gods) to share my home with a number of otters of several species and to observe their behavior from the dual viewpoint of a zoologist and a home owner trying to keep one step ahead of their destructive ingenuity. Both outlooks have given me an excellent insight into the mental processes of otters, often reminiscent of James Thurber's little girl whose book on penguins told her more about penguins than she really wanted to know. Some of the actions of my otters, like their propensity for soaking a towel in the drinking water bowl and then secreting it deep in my bed, are difficult to interpret in terms of the behavior of otters in the wild, but most of what they do can be seen, with a little patience, to be illustrative of normal behavior in free-living members of their species.

The first of the "typical" otters, in terms of what is known about its habits and ecology, is the North American otter, *Lutra canadensis.* It enjoys the status of being so well studied by zoologists for a combination of reasons. It is a darling of the fur trade (and has been even during the few decades now past when furs were being generally ignored by fashion designers), so it has always been a favorite target of trappers. It has also been the victim of persistent libel on the part of fishermen, especially those lacking skill or luck, and the scapegoat for inefficient game fish management practices.

Too many fishermen have labeled the otter a trout-killer and oppose laws that would benefit the aquatic predator. But zoologists have a way of making the best of a bad situation, and there are more zoologists in North America than elsewhere. They have studied the otter in the field, as far as one can do so with a species that has become extraordinarily wary and largely nocturnal in the past century or so—literally to save its own skin. The zoologists have also mirrored the resourcefulness of the otter and have managed to arrange with the trappers to obtain for study skinned carcasses, useless to the trapper but invaluable to science.

The stomachs of otters trapped in several states by biologists or obtained from pelt trappers to investigate the complaints of human fishermen prove beyond doubt that game fish form a very small percentage of the otter's diet. Occasionally, and probably more by luck than skill, an otter takes a trout or some other game species, but the otter displays the all-too-human trait of working no harder for his dinner than he has to, and

The North American otter, heavier than the Eurasian species, has a large, bare nose-pad.

The straw-colored head characteristic of the adult sea otter can be seen here.

crayfish and slow bottom fish form the bulk of his menu. This fact has been so well-documented, so many times, and in so many areas of the United States, that it should be possible to consider the matter closed. Still there are enough anglers who persist in blaming the otter in the face of contrary evidence, and enough trappers who echo their denunciations, to mean continued trouble for the species.

Emil Liers of Homer, Minnesota, the first man to breed the North American otter, discovered a peculiarity in the reproductive pattern—that young are born some 10 to 12 months after breeding. He inferred from this that the otter displayed the phenomenon of delayed implantation, where the fertilized egg, after undergoing a series of cell divisions, ceases further growth and lies quiescent, and loose, in the uterus for several months, implanting in the uterine wall and resuming its development in time to become ready for birth at a propitious time of year. Mr. Liers published his findings in 1951.

A decade later two Cornell professors, W. J. Hamilton, Jr., and W. R. Eadie, proved that Liers' hypothesis had been correct, and they did this using carcasses provided by trappers. (Ironically, the otter carcasses were being delivered at Cornell at a time when I was working for Dr. Hamilton and studying under Dr. Eadie, and was thoroughly absorbed in a study of packrats. I remember seeing the carcasses come in, but in those days no animal could have been as interesting as a packrat.)

Lutra canadensis has a large home range, which it covers more or less regularly over a period of time. As far as can be told, this small-scale nomadism is a mechanism which helps to prevent an otter from depleting the food supply in his hunting preserve. Otters do occasionally go on killing sprees, but not out of a lust for blood. None of my otters would willingly eat fish, yet on several occasions when I was attempting to investigate the prey-catching response of an otter, it would inevitably kill its fish. The otter would then search the pool for another, and if it found a second fish would play out its role of unintentional killer all over again.

One has only to watch an otter playing with a rubber toy, or even with a companion, to see how boisterous the proceedings can be and how forcefully the teeth are used—and all in play. The same bite that punctures a real toy kills a fish. Even an otter living with humans continually forgets how delicate a man's skin is compared to his own thick hide. I find nothing savage or hostile in an otter's camaraderie, but my hands and arms are etched with fine scratches all the same.

The Eurasian otter is essentially a carbon copy of our own species in all of its habits save one. Unlike the North American otter, which brings forth its cubs toward the end of winter and re-mates shortly afterward, the Eurasian otter, as far as is known, may breed in any month of the year (at least in Europe) and gives birth after a straightforward gestation of about two months. The first and last time the gestation was calculated for the species was in 1881, and the figure has neither been verified nor disproved since. In the American tropics cubs are born around the year, also, and such meager evidence as exists indicates that the habits of all tropical *Lutra* except for the marine otter are close to the typical pattern.

Of the remaining kinds of "typical" otters, little is known with certainty. The spot-necked otter, *Hydrictis maculicollis*, is an odd creature. Better adapted for swimming than the *Lutra* otters, with feet more fully webbed than the latter, it has a head more reminiscent of a marten's than an otter's, comparatively more narrow of snout than it "should" be.

According to the little data available, the spot-neck is almost exclusively a fish eater in African lakes, where it preys on species so numerous that the local human fishermen do not consider it a serious competitor. Some observers have said that the spot-neck is a lake dweller, as opposed to the river-haunting clawless otter of the same regions, but the spot-neck probably is not so specific in its choice of habitat, for specimens have been taken in some numbers along river courses.

At times it seems to be gregarious to a degree in Lake Victoria, where the size of the lake and the abundance of fish abrogate the usual need for spacing. The hallmark of the spot-neck is, of course, its spotted neck—usually. The otter's lustrous dark brown underside, different from the muddy silver-gray of most *Lutra* otters, may be extensively dappled with whitish or yellowish flecks, coalescing into irregular splotches. Sometimes the otter's lower abdomen also bears spots, and in occasional individuals the spots are absent altogether.

One field observer wrote that he suspected that

the spotting increases with age, but could not be certain. I was skeptical that such a phenomenon could be likely, particularly because my own spot-neck, Samaki, looks today the way he did when I got him, half-grown, in 1964. A count of his spots is impossible, since some are so small that they join and separate with changes in his posture. But today he has two very small white flecks on the inner surface of one hind leg that I'm sure weren't there two years ago—almost sure, that is.

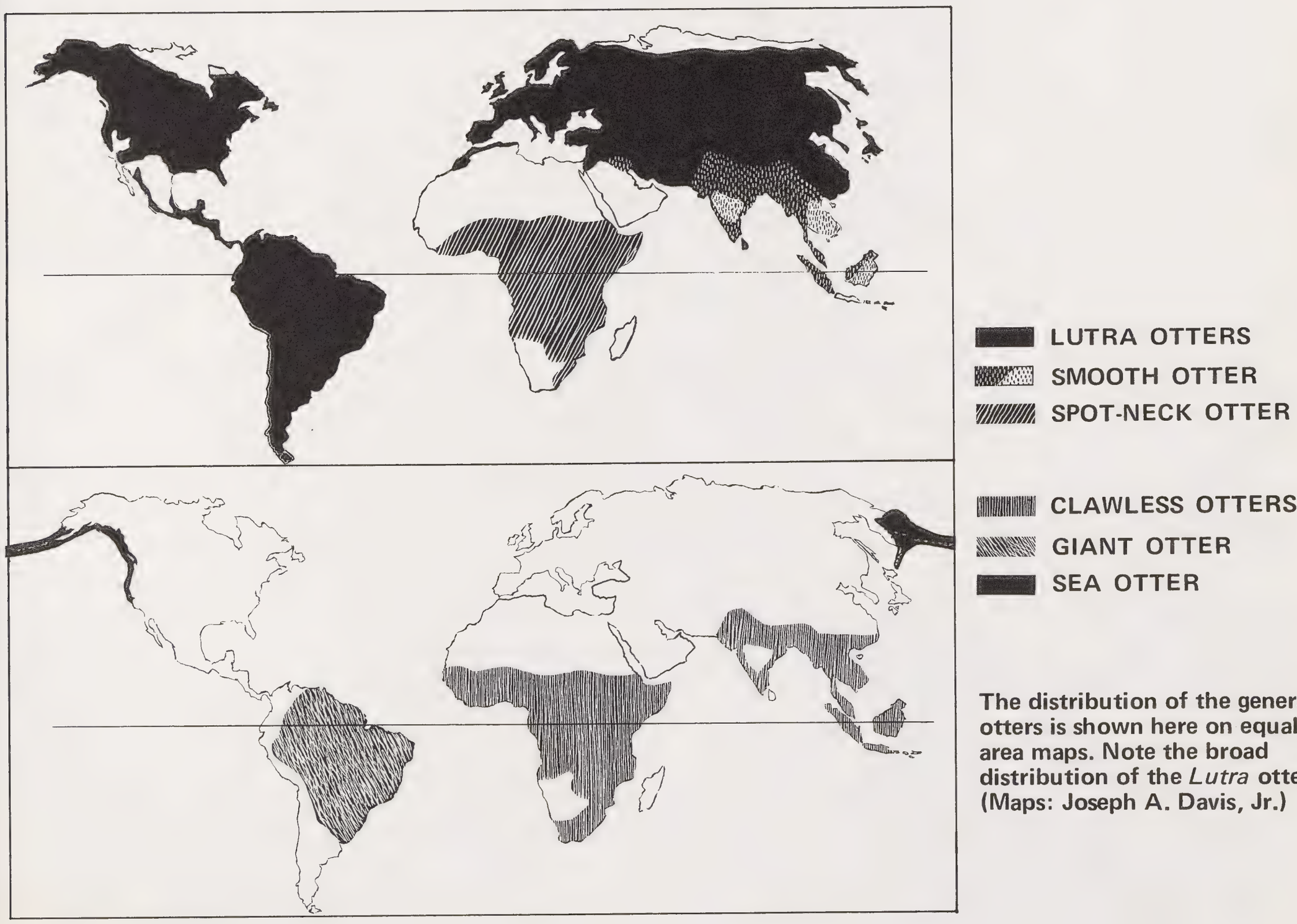
The giant otter of South America resembles the spot-neck in two respects—its feet are more webbed than *Lutra*, and its throat bears yellowish blotches. There the similarity ends. The giant otter has been reported to reach seven feet in length, and its tail differs from all other species in that it looks broader in the middle than at the base, flattened into a thin paddle that might have been patterned loosely after a beaver's tail. The function of this odd lance shape is another of the many things that remain to be discovered, but in view of the use *Lutra* otters make of their tails in underwater maneuvering, it most likely serves this function. The giant's head is unusually shaped for an otter's, too, with something of a seal-like appearance.

Its nose is completely haired, with no bare area, an odd condition that is approached by *Lutra* otters living in the same region and, curiously, also by a species (or perhaps only a race of the Eurasian otter) in Southeast Asia within the same latitudes, roughly ten degrees north and south of the Equator.

Even in areas where otters are hunted and *Lutra* otters have become largely nocturnal, the giant otter has apparently held to its diurnal existence. It has been seen eating fish, but there is no information about the range of its diet beyond a report of one having snared two geese in a river, and vague comments that it may prey on terrestrial vertebrates.

The giant otter has been seen in larger groups than its small cousins, so it may be a more gregarious creature. It is the only freshwater otter now on the endangered species list of the International Union for Conservation of Nature and Natural Resources, and its status is precarious in the extreme over most of its range. The situation is aggravated by the fact that furriers can import pelts under a native name and not pay the duty normally levied on otter skins.

(Next Issue: Part II)



The distribution of the genera of otters is shown here on equal area maps. Note the broad distribution of the *Lutra* otters. (Maps: Joseph A. Davis, Jr.)

British Columbia's Sea Bird Islands

BY DAVID HANCOCK

GULLS SQUAWK, cormorants croak, guillemots whine, and puffins growl. Such are the dubious sounds of welcome as one approaches a sea bird colony in British Columbia. More disconcerting than the deafening bird sounds of alarm, fright, and aggression are the aerial attacks by the gulls. One after another, the attackers make their raucous dive-bombing swoops as the intruder carefully foots his way between the crouched chicks and the nests cradling browny-green mottled eggs.

Will the gulls strike? The thought of their three-to-four-inch-long bills raking cross one's skull is not pleasant. The gulls come close, but veer away just before making contact. The intruder's apprehension gives away to confidence. About this time, he decides to ignore the airborne vigilantes, and gets abruptly clouted across the back of the head with a forceful wing butt.

Sea bird colonies are located along both coasts of our continent—wherever isolation offers the birds protection from land predators. Each year my wife Lyn and I visit such colonies off the British Columbia mainland to study the birds' habits. Usually the islands are small, storm swept, and treeless. They are often no more than barren rocks with grass eking out a precarious hold in the crevices against the wind's force. Our favorite is Triangle Island, a tiny islet, omitted from most maps, some 50 miles off the northern tip of

Author David Hancock climbs down a cliff on Triangle Island to photograph the sea birds.

A glaucous-winged gull, startled by human intruders, flies over the island.

Author Hancock and wife Lyn feed the murres collected on Triangle Island.

For the stay on Triangle Island, a tent was set up on a driftwood slope, the best available camping site.

Vancouver Island, B.C. The island is a haven for the largest sea bird colony on the British Columbia coast. Its massive dome projects 760 feet up into the often mist-and-fog-filled sky. Here we are able to carefully explore the intricate web of life of the dozens of bird species that surround us at all times.

However, people don't really belong on a breeding rookery. In addition to the inevitable damage of trodden eggs or crushed young, the greatest hazard to the nesting birds is indirect. As the gulls and cormorants are forced from their nests by the human intruder's presence, the ever-alert crows quickly move in to abscond with the unguarded eggs or tiny downy chicks. Several hundred eggs and young may be lost in a few minutes if intruders are not cautious, and some will be lost no matter how careful the investigator.

Death occurs in other ways also. When a young gull chick is disturbed it runs away from its nesting

area. Once displaced from its own territory, a young gull's chances of survival are small. Adults usually kill all chicks in their territory other than their own.

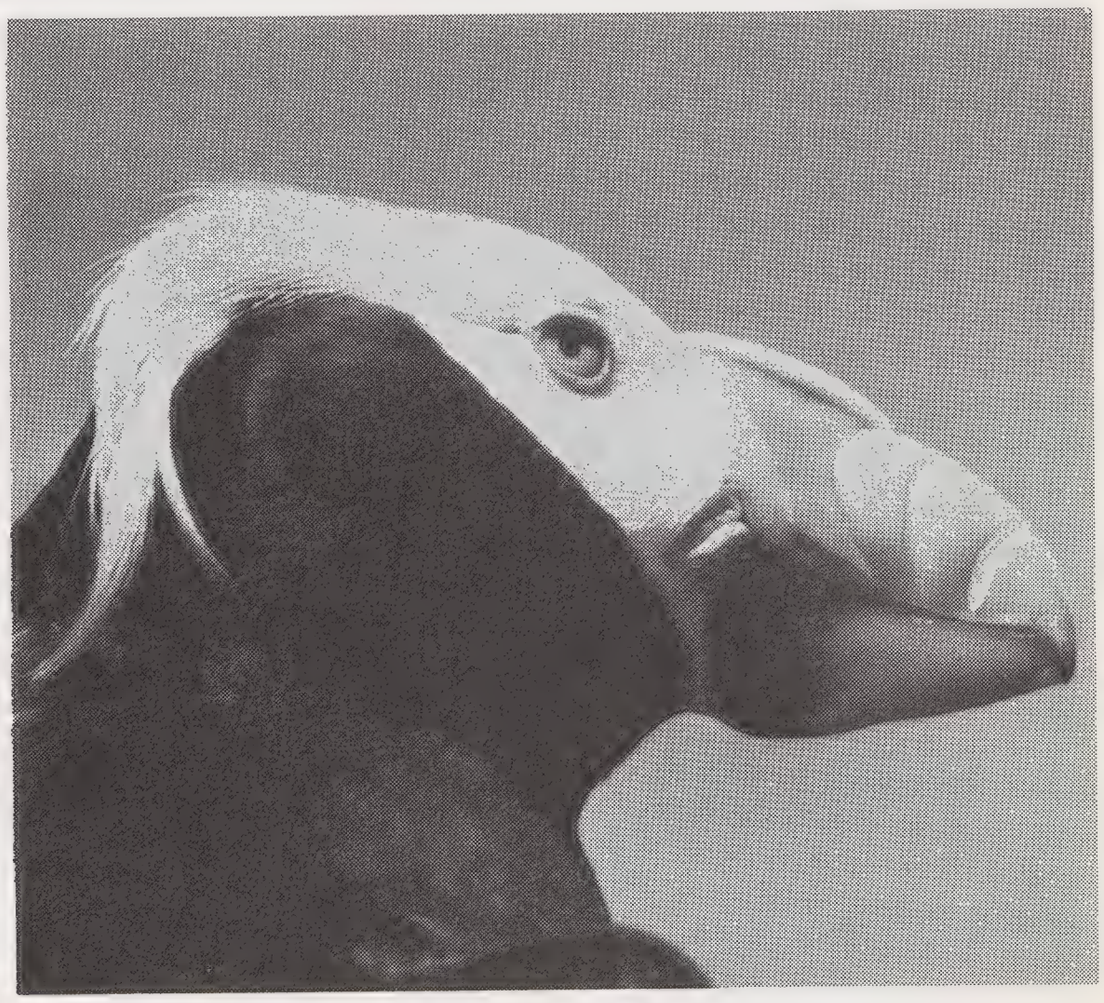
Because of the unintentional destruction that human disturbance can have on a rookery, these islands are usually designated by the wildlife authorities as game preserves and access is prohibited except under permit.

If the intruder cautiously conceals himself in a blind, the colony quickly settles down to a bustle of normal activity. The parent gulls settle on their territory. Their young squeaker suddenly emerges from a tiny rock crevice where it had been crouching motionless and perfectly camouflaged. The female gull bows her head, hunches her neck, and regurgitates some partly digested fish which the youngster greedily takes from her throat.

Then black cormorants return to their nests on the cliff. With a rush of wings and a few hoarse croaks, a large double-crested cormorant flops onto her nest. The naked, black-skinned nestlings start to struggle as soon as the nest is shaken. Immediately, the parent stands over them to protect their tiny prostrate bodies from the blistering sun. A few drops of water from the adult's feathers stimulate the helpless young to lift their large heads. A few seconds of wobbling at the end of a long feeble neck and all heads flop down again. Sixty yards down the cliff, the smaller pelagic cormorants sit contentedly on their eggs with their throat or gular pouches panting. The only disruption occurs when a bird arrives back at the nest to find a neighbor pilfering some of its nest material. After some head lunges and grabs at another neighbor's nest to try and make up the loss of material, peace again prevails—for another second or two.

Overhead, a glaucous-winged gull dive-bombs a tufted puffin returning to its burrow with a beak full of tiny herring—all neatly dangling by their heads in the powerful bill. The gaudy puffin does a quick sideslip using its big red feet as rudders to evade the raiding gull and flies headlong into the safety of the nesting burrow. The bird waddles four feet along the burrow to a cavity where her single downy chick awaits its dinner. All along the grassy slopes outside are social gatherings of billing and growling puffins displaying their beautiful breeding colors.

A nesting colony of double-crested cormorants is viewed from further up the island cliff.



A tufted puffin displays the breeding plumage of golden feathers arising behind the eyes.

For 40 days, Junior's food requirements keep the parent puffins busy fishing from dawn to dusk. Then when most of his warm black down has been replaced by feathers, the young bird's parents desert him. By this time summer is waning, and the parents' red bill sheath is sloughing off and their golden head plumes are moulting out. After a week or ten days of living off his fat reserves, Junior leaves his tunnel home. Under cover of darkness, he works his way down the grassy slopes

to the cliff face and launches himself toward the infinite sea. By dawn he is several miles from land and the dangers of predacious gulls. Without parental care, he learns to swim, fly, and hunt his own fish.

Just above the tide line, a group of pigeon guillemots sun themselves on the rocks between feeding trips to their burrows or rock crevice nests. Their bright red feet contrast with their sleek black-and-white breeding plumage. Returning from the sea with a bright green and still-wiggling blenny in its bill, a parent flies into a crevice just over our heads. Faint squawks are heard as the two youngsters fight for the single fish. The parents quickly emerge and return to sea for another load. Our presence in the rocks flushes a pair of raucous oystercatchers whose long chisel-shaped red bills are used to pry open shellfish.

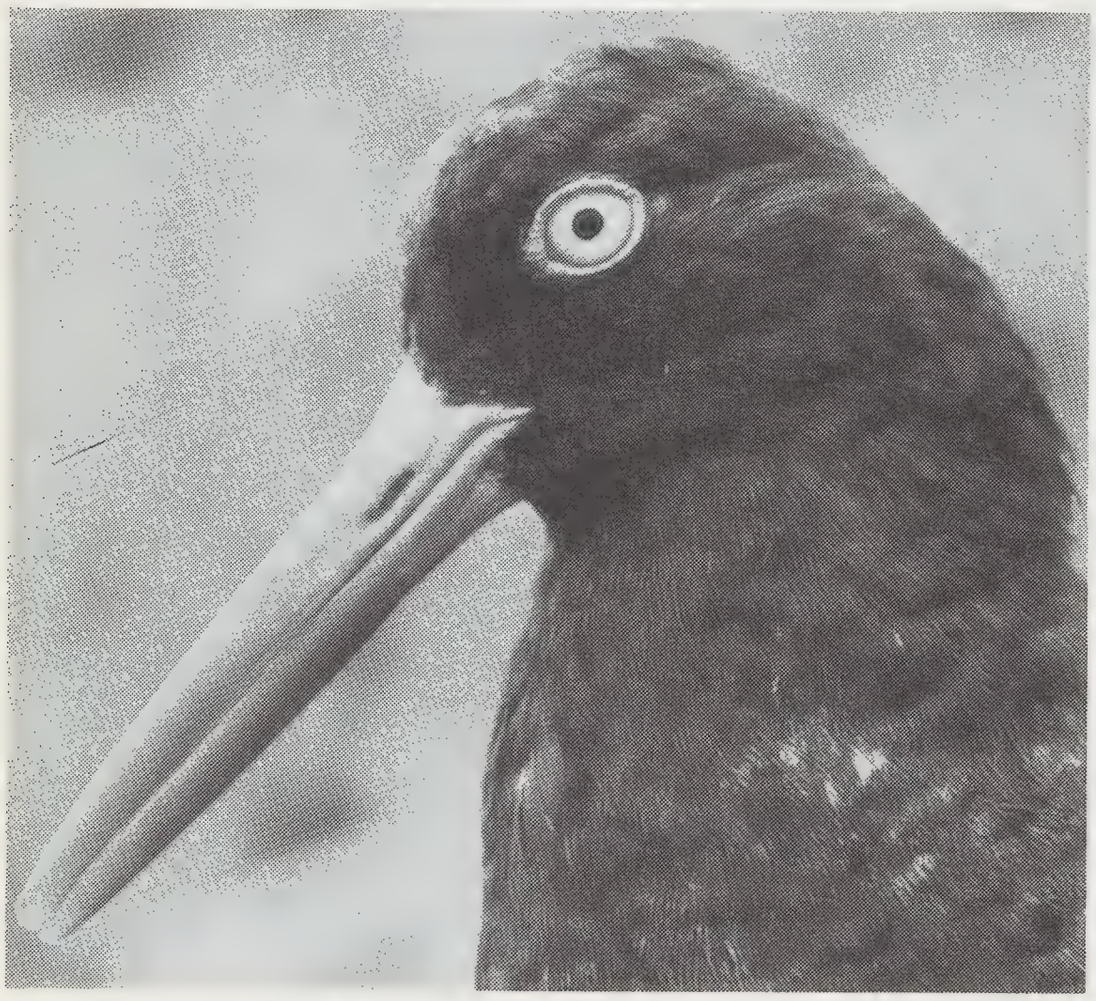
The puffins and guillemots belong to a large family of birds known as alcids, or the diving sea birds. These birds are fish or plankton feeders and swim underwater using their wings.

Among the most interesting island residents are murres, the "penguins" of the Northern Hemisphere. A few years ago, my wife Lyn and I visited Triangle Island, to observe there the only existing colony of Pacific murres, relatives of the extinct great auk.

Our first view of the murre colony held us breathless—hundreds of murres were bunched tightly together on narrow ledges. A new arrival from the sea alighted in their midst, wings and head pointing skyward. This caused much squabbling and increased noise. All neighbors growled and moaned and jabbed with their long sharp rapier bills in the direction of the newcomer. Soon the disruption had telescoped along the entire ledge. Finally those adults incubating eggs settled down and busily attempted to turn and ruffle their beautiful brown-and-green blotched eggs under their white bellies for warmth. This was a delicate job—an uncoordinated movement on the adult's part and the egg might roll an inch to the left and be lodged in a deep crevice, or roll to the right and disappear over the 300-foot cliff. If the egg remained exposed for more than a few seconds, a vigilant glaucous-winged gull would swoop down and steal it.

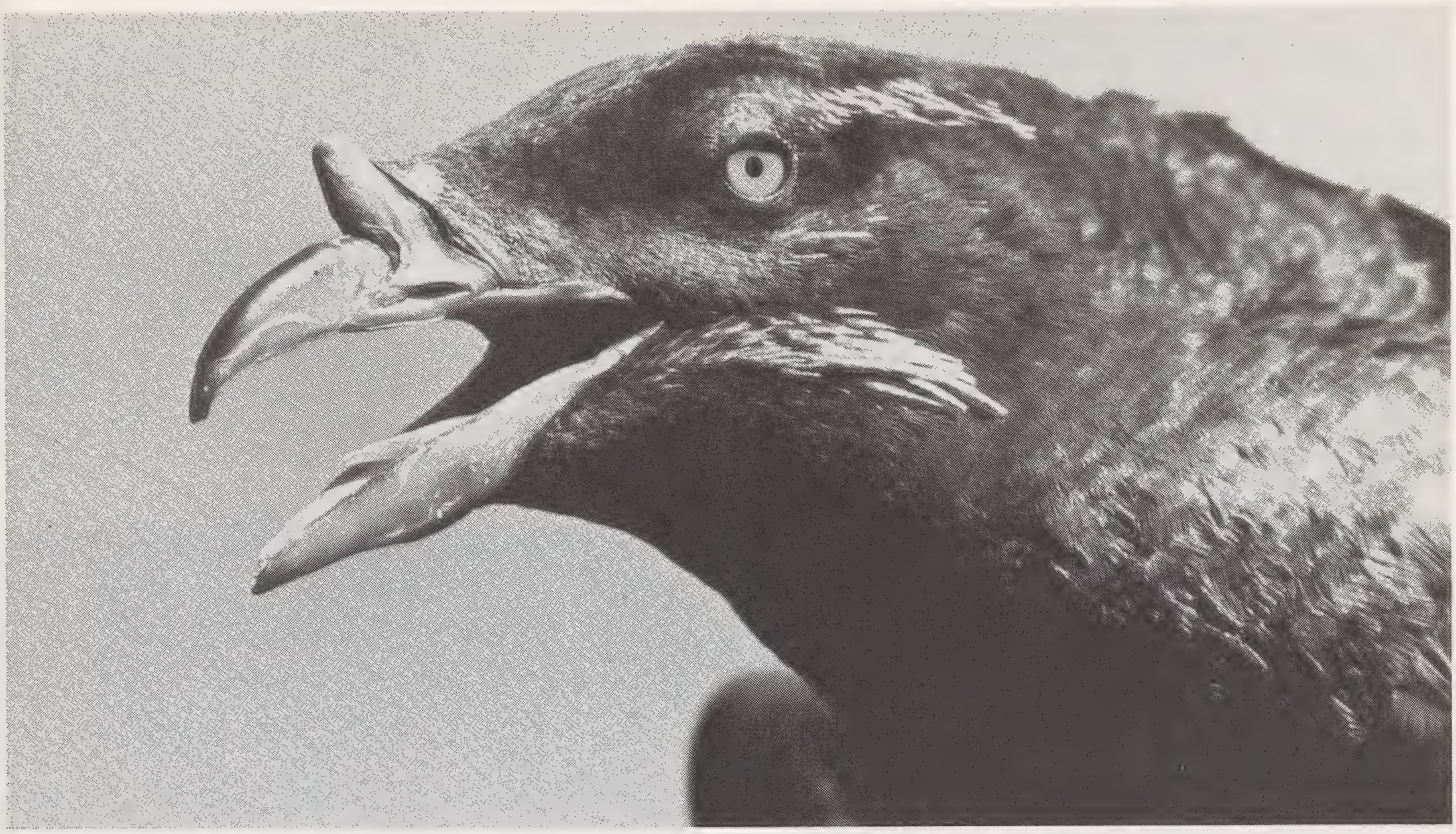
Murres belong to the alcid family as do the smaller murrelets and auklets. These latter species fly to and from the seclusion and protection of their nesting burrows only under the cover of darkness.

Another nocturnal species is the diminutive petrel. These burrow-nesters are one of the few representatives of the albatross and shearwater group that nest in the Northern Hemisphere. The tiny burrows are so narrow and twisted that to see the grass-lined nest cavity, it is necessary to excavate the tunnel. The delicate adults have little



The oystercatcher's knifelike bill with its "chisel" tip is used to feed on mussels, clams, and oysters.

A recently hatched murre chick stays close to its mother in the midst of the murre colony.



The rhinoceros auklet gets its name from the blunt horn that develops at the base of its beak during the breeding season.

means of defense although they do have the unpleasant habit of forcefully disgorging the half-digested crop contents when disturbed. This oily plankton mass can be accurately directed several feet and certainly serves to deter most humans. Only a single egg is laid and is incubated by both parents, each adult sitting from four to six days before being relieved. The little brown chicks are very slow growing and remain in the nest about 70 days before they venture off into the world on their own.

A sea bird colony is a beautifully complex structure. Generally isolated from destructive mammalian predators except man, birds of many species and diversified requirements live together in an intricate web of conflicts and mutually beneficial interaction.

The closeness of the nesting gulls necessitates that they compete with each other for mates, space, and nest material, yet their combined mobbing behavior can effectively reduce predation and help drive away predators in a way that would not be possible if they nested singly. Similarly each species requires a slightly different type of habitat in which to nest. The cormorants select cliffs with a certain slope and ledge structure; the gulls, the level grassy areas between rocks; the puffins, the grassy and earthen areas in which to burrow; the guillemots, the rocky crevices just above the high tide; the oystercatchers, the open rocks just out of wave reach; and so on. Each species may be limited by the availability of food, suitable nesting space, and competition with other species. Each pair will be further limited by competition with members of its own species.

If the puffins cannot dig a deep enough burrow, the gulls will get their eggs or young. If the gulls do not guard their own eggs, other gulls or crows will steal them. If the cormorants are forced to nest too closely together, they may spend so much of their time haggling over nest material that eggs and chicks will die from improper care. The numbers and distribution of each species are dependent upon the numbers and distribution of many other species.

In nature's ever changing yet beautifully balanced system, the loss of one's individual eggs or young usually benefits another individual. The gull chick benefits by the egg its parent stole from the quarrelling cormorants. And the cormorant which now deserts its empty nest perhaps lessens the disturbance to neighboring cormorants so that there is a greater chance for the previously too-close neighbors to successfully raise young.

ZOO PORTRAITS BY PAUL G. KOVAC

Paul Kovac's magnificent photographic studies of zoo animals last appeared in **Animal Kingdom** in the April 1967 issue. Happily, Mr. Kovac has continued to train his lens on animals during his frequent visits to the Bronx Zoo. These pages feature some of Mr. Kovac's more recent work. Mr. Kovac, a financial analyst on Wall Street, is an amateur photographer with an abiding interest in photographing zoo animals. His photographs prove that visits to a zoo can produce photographs of wildlife that have an intimate drama which can compare with those taken of animals in the wild.

1. **White rhinoceros** *(Cerathotherium simum simum)* **and cattle egret** *(Bubulcus ibis ibis)*
2. **Chilean sea eagle** *(Buteo fuscescens australis)*
3. **Asian water dragon** *(Physignathus cocincinus)*
4. **Common iguana** *(Iguana iguana)*

2

3

4

5. **Emperor goose** *(Anser canagicus)*
6. **and 7. Guanay cormorants** *(Phalacrocorax bougainvillii)*
8. **African spotted leopard** *(Panthera pardus)*

6

7

8

ROUNDUP
on the bison range

by Stan Federman
Photographs by David Falconer

THEY CAME POUNDING up over the ridge as excited shouts of "there they are" resounded in the corral areas down below. For a brief moment, it seemed as if the ridge itself were alive—a black mass of movement outlined against the bright blue Montana sky.

Then they were thundering down the steep hillside in wave upon wave of action, recalling for a spectacular few moments another era when their ancestors roamed the Great Plains by the millions. For these were American bison, a living heritage of this nation's past.

Down, down the animals surged, galloping ahead of whooping cowboys on sweating horses, who were herding the bison toward the corrals after a morning-long journey up from the grazing regions of this 18,000-acre range. As they swept down the hillside, the animals were packed almost shoulder to shoulder along the width of a trail that was stoutly fenced on either side. Several times small groups of bison would crack into the fences, which groaned under their awesome weight.

Huge bulls, some weighing more than 2,000 pounds, bellowed as they roared by newspaper and television photographers grouped halfway down the hill. Beads of saliva dripped from the mouths in those massive black heads topped by the short but sharp horns. Cakes of dried dirt covered the ruffed brown fur of their humped shoulders. Cows, shepherding their small calves, snorted with fright as they sped by, shying away from the leery cameramen crouched in worried safety behind the wire fences.

"It's like watching history," shouted one excited photographer as the herd of almost 500 bison raced down the half-mile-long hill.

Clouds of dust shrouded the horsemen riding hard behind the herd. Now and then a cowboy would peel off the riding line to block an escape route of some beast attempting to turn back.

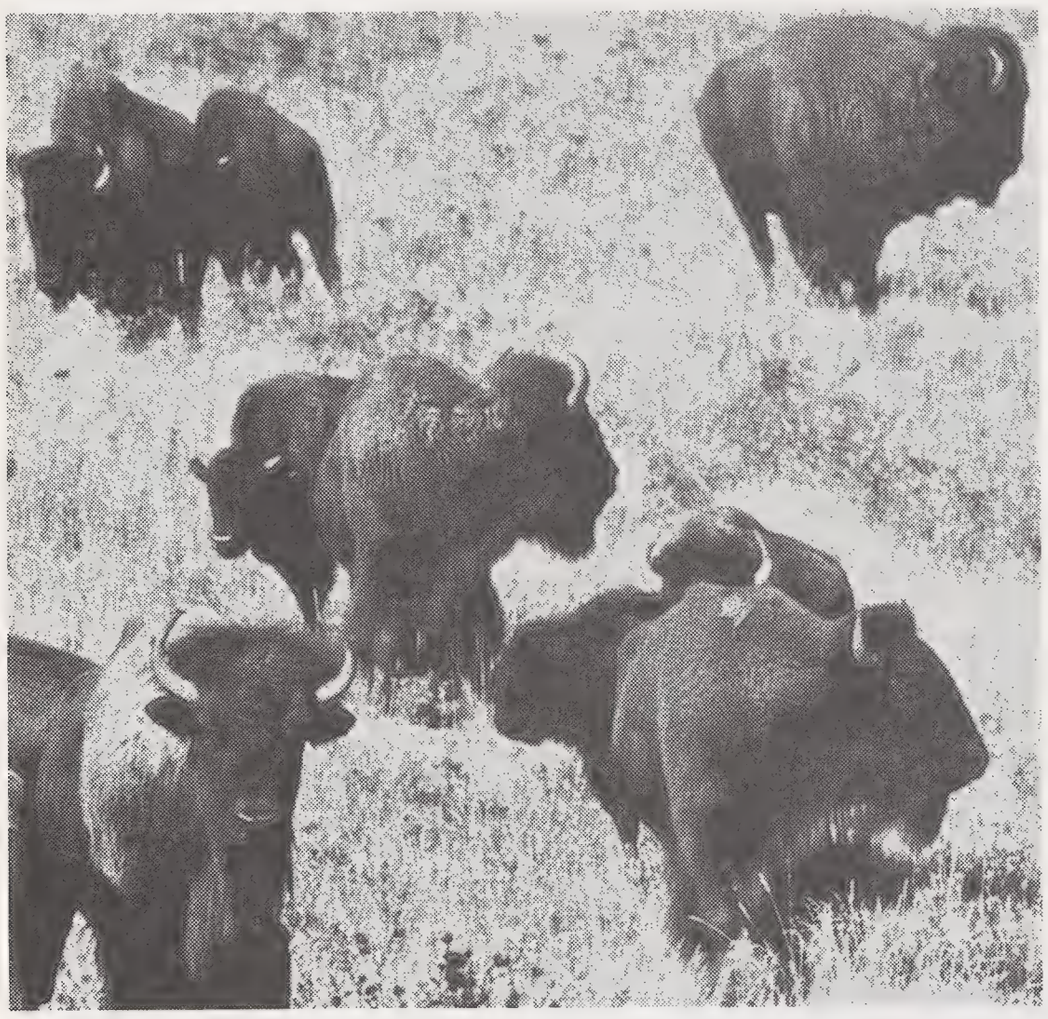
Finally the bison were at the bottom of the hill and the cowboys yelled and yipped them into a 90-degree turn toward the waiting field corrals. Then all the bison were rushing into the enclosures, sweeping along their entire length, testing the fences, and at last coming to a panting, bellowing halt in the middle of the corrals.

About 250 visitors watching from a catwalk on the maze of work corrals some distance away shouted their congratulations to the cowboys for a job well-done. And on a small hill overlooking the field corral area, busloads of school children excitedly gazed upon the panting herd and listened in wonder as the bulls continued to bellow their defiance.

A short time later, the cowboys and members of the United States Fish and Wildlife Service began the main job of this annual roundup at Montana's National Bison Refuge—the penning of each animal in small "recording enclosures" to observe them and gather vital range management information.

Yearling bison would be recorded and, if selected, be sent barreling through the tight corral chutes to a special pen, there to await truck shipment to buyers. They would be used to propagate other public and private herds throughout the nation—one of the chief reasons for the existence of the Montana refuge. Last year, for example, five bulls and five heifers were shipped to the New Mexico Department of Fish and Game to help start a bison herd in that state.

Cowboys drive the bison herd toward the waiting corrals.



At first the bison are tense and nervous in the corral field areas.

The bison drink heavily after the morning-long gallop from the grazing area.

Many animals would be thinned from the herd for future slaughtering. The refuge sells butchered bison meat to individuals for their frozen food lockers and to market and restaurant chains.

Roundup time on this magnificent range is an exciting week-long event every October in the beautiful Mission Valley between the Continental Divide and Mission Mountains. The refuge itself is located in Moiese, about 45 miles north of Missoula, and is one of the nation's oldest big game sanctuaries.

For the cowboy herders and Fish and Wildlife personnel, the roundup is a tricky, dangerous operation. Every man is proud to be working it and each seems to have a special fascination with the bison.

The herders are all excellent horsemen and in the valley they are quietly admired for their courage and skill. Each herder earns about $2.50 an hour for his roundup chores. But more than one spectator from the safety of the catwalks has exclaimed that "you couldn't get me to do that job for $100 an hour."

The sheer bulk and strength of the bison, even in the corral enclosures, never ceases to both startle and dazzle roundup visitors. But the bison's actions are well known to the herders. They have to know them; failure to understand the beasts could cost a man his life.

Grant Hovde, a sun-creased herder with the lean drawl of most Mission Valley residents, has a deep respect for the bison. Like most herders, he calls them "buffalo," the name usually applied to them by most Americans.

A bison is a difficult animal to herd because the herders cannot get too close to one or it will charge. "And you can never figure one out," says Hovde. "One time an animal will just stand there looking mean at you—and then sashay off. The next time, the same buffalo will try to put you and your horse up on a fence."

Dave (Babe) May, refuge foreman, puts it bluntly: the only predictable thing about a bison is that it is unpredictable.

May points out that the bison are deceptively fast animals and can go at a dead run for long periods of time—with a symmetry of motion all their own. Their dark, humped shoulders rise and fall as they gallop along, and it often seems as if they are on some sort of pogo stick with all four feet in the air at one time.

A bison may charge a rider and horse at any time. The bison could slam into the horse, toss it off balance, or gore it. The panicky horse could then throw a herder to the ground—and this is the major worry of every cowboy in the roundup.

"If you get throwed, your best bet is to freeze," says May. "A buffalo has very poor eyesight and usually will not charge a still object. If you lie real quiet, he'll scare the daylights out of you with that stare of his—but then he'll amble away in a minute or so. But if you try to run—you'll be dead. Nobody outruns a buffalo."

All over the globe, no large mammal except man himself was ever as numerous as were the bison which once roamed the North American continent from Canada to Mexico. No one really knows how many there were; the best guess seems to be about 60 million.

In the regions where they thrived best, the Great Plains, they often covered the prairie like a vast blanket as they slowly moved in great circular, seasonal migrations, cropping the lush grasses.

However, with the coming of the white man, the days of the bison became numbered. At the close of the Civil War their ranks had been cut almost in half, but millions still ranged from the Missouri River south to the Pecos. Then in the fall of 1867 came the Union Pacific Railroad, pushing its tracks westward. And the railroad brought doom for the great herds.

With their .50 caliber buffalo guns and curved skinning knives, the hunters followed the herds relentlessly, dropping animals by the hundreds and thousands. Some were shot for meat to feed railroad construction gangs, others for hides, which were shipped back East to tanneries located along the newly-laid tracks. Some were killed only for their tongues; buffalo tongue was a gourmet's delight in that era.

The Indians, whose existence depended upon the bison, were worried and angered by the incredible waste. "Why do you kill and not eat?" asked an old chief at a Kansas treaty conference. Treaties were made and regularly ignored by the insatiable hunters, lured on by the promise of wealth at $3.50 a hide. Many Americans deplored the slaughter and were sickened and saddened at how the West was being won. But their protests were drowned out by the railroads, hungry for profits in hide hauling, and the empire builders, who were unanimously agreed that every dead bison eventually represented a dead Indian.

By the early 1900's, wildlife experts estimated there were less than one hundred wild bison left in the United States—plus a pitiful few small private herds in which there might be another hundred or

The cowboys cut about 20 head from the main herd at a time to run up to the working corral area.

The fast-moving animals are turned into the working corral area.

Long bamboo poles with tin cans are used to prod the bison into the pens.

so. Just as there are many American animals and birds of today that are bordering on possible extinction, the bison at that time was in need of man's help if the species were to survive.

Fortunately public sentiment was at last moving in favor of the bison. Action to preserve the species soon occurred at the federal level when Congress designated 61,500 acres of Oklahoma's Kiowa-Comanche Reservation as a forest reserve. Four years later President Theodore Roosevelt officially proclaimed the Oklahoma forest reserve as a game preserve dedicated to the preservation of wild animals.

(Dr. William T. Hornaday, then director of the New York Zoological Park, proposed that the best method of saving the bison was to establish national herds maintained by the federal government on large areas of grazing territory. The creation of the Oklahoma preserve—the Wichita Game Preserve—presented an excellent opportunity for this course of action.

In line with Dr. Hornaday's proposal, the New York Zoological Society provided 15 animals from the zoo as the nucleus of the Wichita herd. The nucleus herd was delivered in 1907 after the government had completed the erection of a fence around the 8,000 acres set aside for the animals.)

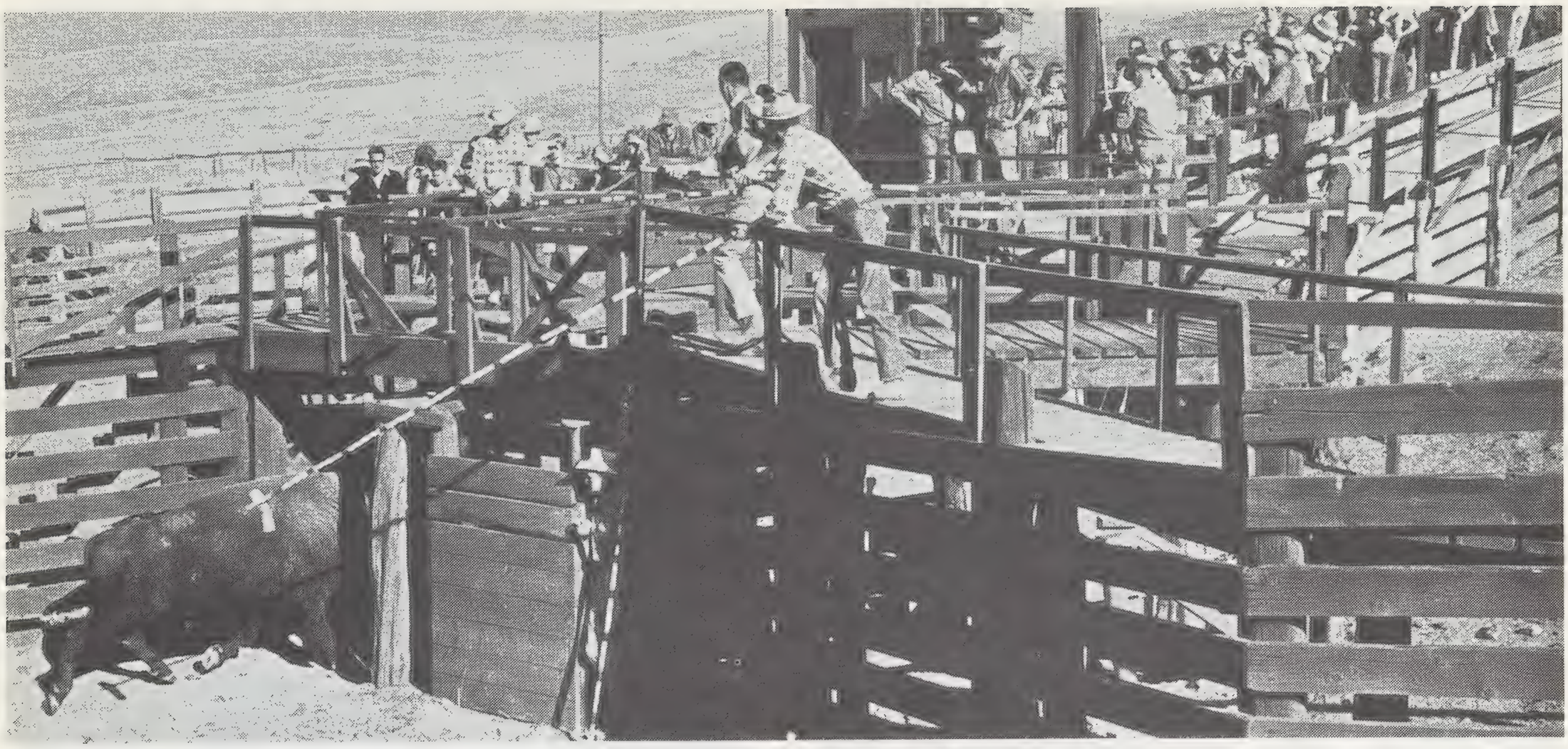
Meanwhile the American Bison Society had been formed at the Bronx Zoo in 1905 to encourage establishment of other herds under government protection. This organization inspired establishment of the Moiese refuge. President Theodore Roosevelt obtained Congressional approval for the Montana land purchase—and the Bison Society raised $10,000 by popular subscription to stock the range. The first animals were released there on October 17, 1909.

The famed "buffalo grass" that was so important to the fabulous herds of the Great Plains does not grow on the Moiese range, but there is ample nourishment in the rich bunchgrasses that cover it. Although snow sometimes piles up in huge drifts during a rugged Montana winter, the bison are quite self-sufficient and easily forage through the snow. Their fur is so thick that often in blizzard conditions that would kill cattle, they will face directly into the storm—and survive.

Large, open grass pastures with a plentiful supply of fresh water are best adapted for their needs, and the refuge has these. In addition, it has many trees and large rocks which the animals use

From the safety of the catwalk above the chutes, a cowboy tries to move a stubborn threesome.

Once set in motion, the animals will usually just keep going and need directional encouragement.



After being prodded along, the bison finally start through the door into individual chutes.

as rubbing sites, another factor in their well-being. In spring, the bison shed their wool in patches and rub it off on trees, rocks, telephone poles—anything they can find. Their skin at this time is more exposed to flies, mosquitoes, and gnats. The bison therefore coat their hides with mud by rolling around in wallows that they create themselves out of range water areas.

Since bison, like sheep, have a habit of compact herding, portions of their range quickly become denuded of grass, thereby necessitating a reduced rate of use. Pastures are rotated yearly to offer better utilization of forage.

Bison calves are usually born in the spring, although some are dropped at the start of summer. New-born calves are reddish in color and retain this natal coat for about three months when it is replaced by the dark brown coat of the adult. Calves weigh between 30 and 70 pounds at birth, grow rapidly, and by a year may weigh from 300 to 700 pounds. Adult cows will weigh as much as 1,000 pounds; many bulls are over 2,000 pounds.

At the roundup, herders will "cut out" 20 to 25 bison at a time from the main herd and chase them into the working corral areas. Here the animals are run into individual pens to be recorded. Afterward they are sent into other pens along the corral line, depending on what is to happen to them.

To get the bison into a recording pen, herders and wildlife personnel use long bamboo poles to which are attached empty food cans. These "prodders" are shoved into the bison to get them to move. Often as not, the poles merely make them angry and more stubborn than usual. Sometimes they will move and sometimes they will not. Often a cowboy will have to climb halfway down a corral fence to "work" on a particularly stubborn animal. More than likely, the bison will charge the man and force him to scramble back up the fence.

As each animal is recorded in the refuge's range management books, foreman May looks it over carefully for signs of disease, age, or any deformities. He is the one who decides whether the animal will be returned to the range, sold, or butchered. After he shouts his instructions, the proper gates are opened and the animal is chuted through to another corral area.

Many range bison are sent to the weighing pen where their size is recorded. The refuge keeps a yearly check on the various age groups within the herd so as to study their aging processes. About three-quarters of the herd are returned to the range for another year of grazing.

The only animals sold are yearlings of about 18 months because of the difficulty in handling the older animals. There are usually more buyers than bison and a drawing is held every year at Moiese for the animals. Only two bison can go to an applicant, although there are exceptions such as state game departments or zoos seeking to build up existing exhibits. Each buyer is carefully

screened by the Fish and Wildlife Service. Most private herds are confined to 10 animals or less. There are some larger herds in the 300 to 1,200 class in the West—but these are operations which raise the animals for commercial purposes.

In selecting an animal for butchering, the refuge's choice is conditioned by the age and health of the animal. Joseph Mazzoni, the refuge manager, notes that although an animal may be old, it will be kept on the range if it is healthy. Many of the bison live out their entire lives at the refuge. "Our major responsibility here is to keep a representative herd for the future," says Mazzoni.

All calves are shooed into what is called "The Squeezer"—a bright red iron grating with bars that holds the frightened animal in a scissors-like grip. Refuge veterinarians then vaccinate the calf with an anti-brucellosis shot in the rump.

Besides the bison, the refuge is also home to herds of Roosevelt elk, white-tailed and mule deer, bighorn sheep, mountain goats, pronghorns, and a few Texas longhorn cattle. There is an exhibition corral at refuge headquarters where several of the animals are placed on display for summer tourists. Tourists are also permitted to take a 19-mile self-guided auto tour of the refuge. This offers an excellent chance for observing most of the animals in their natural habitat, although families are fortunate if they can catch a look at the sheep or goats which are seen only rarely in the range's higher elevations.

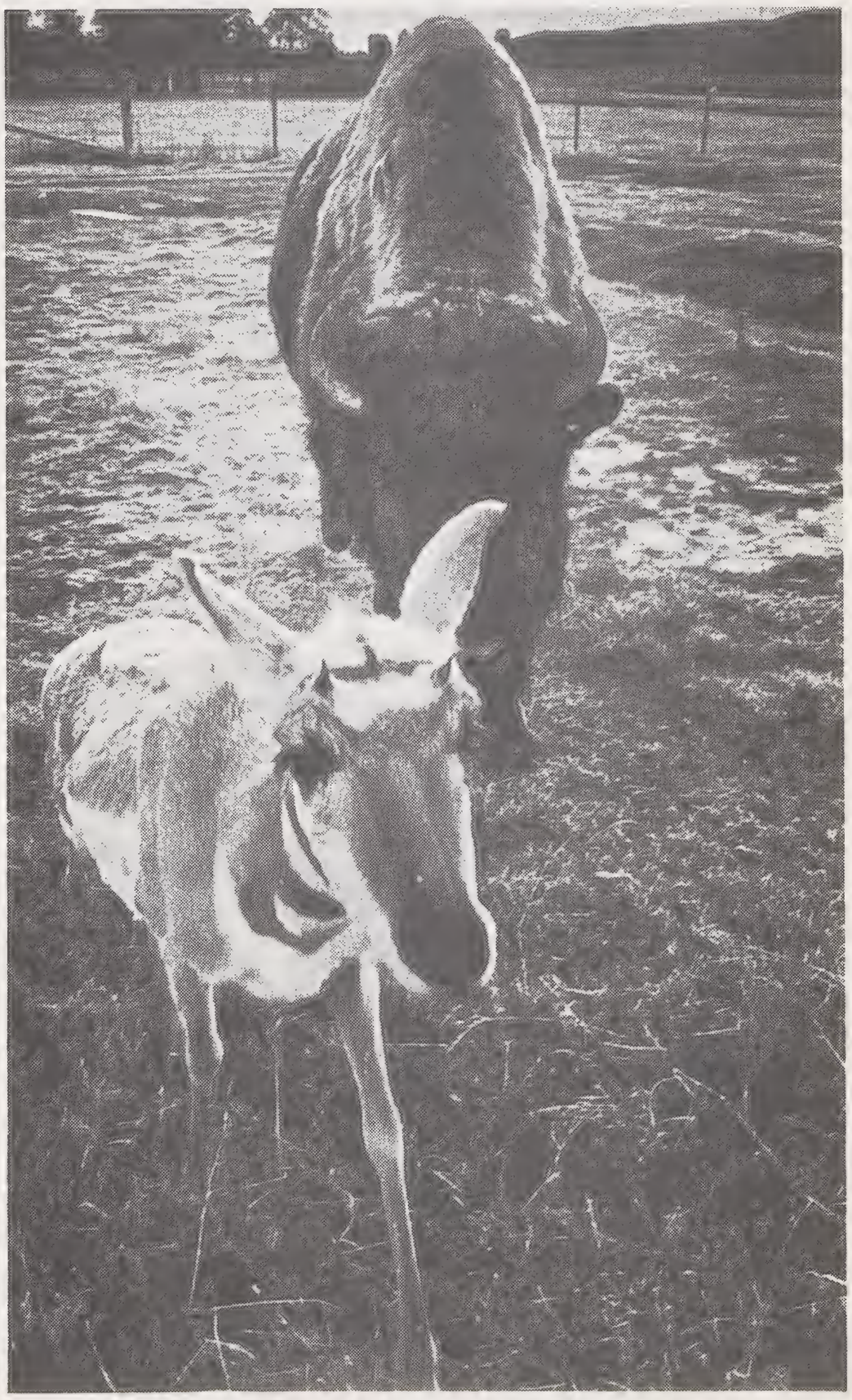
The bison can always be seen in their grazing areas which are close to the tour road. Sometimes in August during the mating season, a pair of bulls will square off against each other and fight for their lady. They will pound at each other until one gives up—but often the noise will be more frightening then any physical damage they may do to each other.

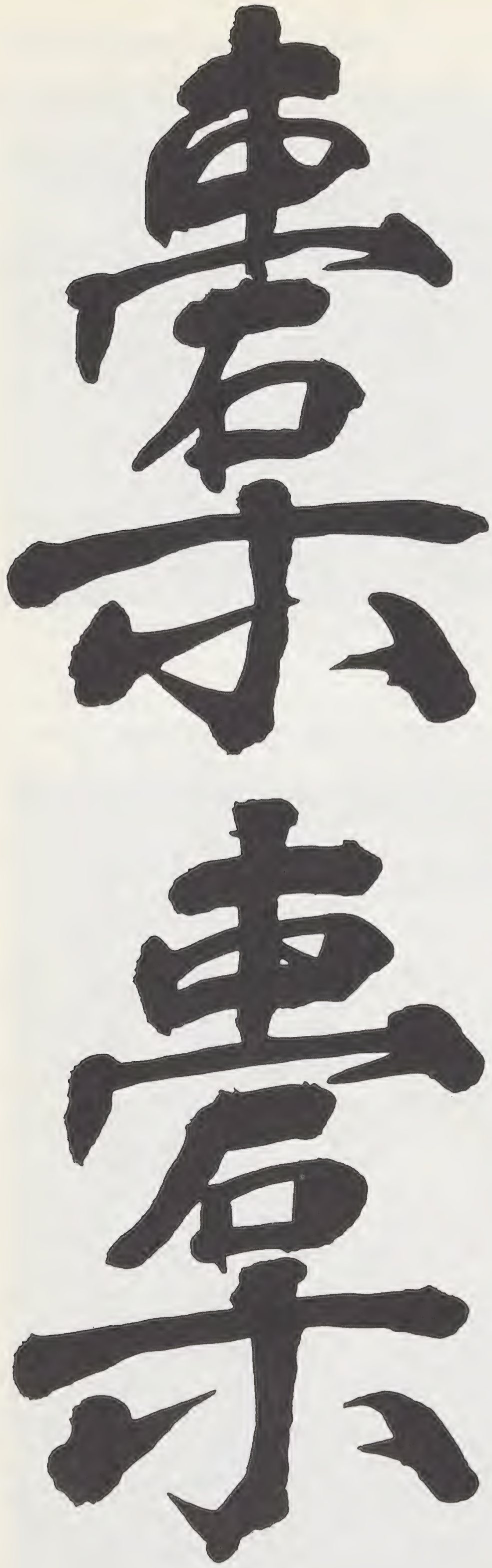
The Fish and Wildlife Service estimates there are about 10,000 bison "back on the range" in America today. Much credit for this number belongs to the Service's excellent range management practices which have helped the bison not only to survive but to propagate for future generations to enjoy.

Moiese's annual October roundup is where one can see first hand the success of modern wildlife management and the addition of a proud new chapter in western tradition.

The cowboy will drop the door behind the first bison, enclosing it in a recording pen.

Below, "Clunk," a refuge pet, and a pronghorn doe entertain the many visitors to the exhibition corral.





Chinese calligraphy for the sound T'o, representing the call of the Chinese alligator.

BY PETER BRAZAITIS

The young men listened as the ancient storyteller spoke, his words conjuring up visions of the coming hunt. Soon it would be the ninth moon, the time when the T'o is killed for its skin, which would be fashioned into drum heads for the court of the emperor. The men of the village had heard the deep, coughing call of the beast, resounding in the night from some secluded place deep in the great Taiping marsh. The word "T'o" was said to describe the very call itself—a name and sound shrouded in legend and folktale since it was first mentioned in one of the oldest of Chinese records—*The Classics, 26th Chapter of the Doctrine of the Mean.*

During medieval times, Europe heard stories of a strange scaly animal in the East that spent much of its time within the earth and ventured forth at night to leave a path where it dragged its body through the mud. Marco Polo visited the Chinese province of Yünnan in the year 1280 and reported the presence of a huge serpent with forelegs that emerged from burrows after dark and undoubtedly ate sailors. Natives, he mentions, set sharpened stakes on the paths leading to the burrows hoping the creatures might impale themselves.

Swinhoe, a naturalist who often collected reptiles and amphibians in China for the British Museum, first reported in 1870 that a true crocodilian inhabited the regions of the lower Yangtze River. Nine years later, a Frenchman named Fauvel, then in the employ of Chinese customs, described and named the Chinese alligator, *Alligator sinensis.*

Considered a dwarf among crocodilians, this rare and inoffensive relative of our American alligator, *Alligator mississippiensis,* reaches a maximum adult length of about six feet and a weight of 75 pounds.

Adult Chinese alligators are usually gray in color, with lighter, rather indistinct bands on the body and tail. Hatchlings are often vividly patterned in yellow, gray, and white. Legends to the contrary, the creature's fierceness has proven to be mythical.

In 1921 and 1922 various museums attempted to secure specimens of the Chinese alligator and also dispatched investigators to study the reptile in its native environment. Most of the alligators encountered in these efforts were dug from deep burrows during the season of hibernation, which extends from October to March. A large share of

subsequent studies have also been undertaken at this season when, unfortunately, the animal is least active. This makes study of its habits difficult and, therefore, little is known of the Chinese alligator's life history.

Between 1956 and 1963 the Bronx Zoo acquired three Chinese alligators: a male from the Warsaw (Poland) Zoo, an adult female from the Cleveland Zoo, and a young female from an animal dealer in the Netherlands. With the development of a sexing technique in 1963, we decided to try and breed our animals.

The Chinese alligators were first placed in their own enclosure which contained a small pool. This provided both an interesting exhibit and security for the reptiles, which might not have done well in a colonial exhibit with larger, more aggressive crocodilians.

The next step was to scan available literature about the Chinese alligator but the results were not encouraging, for the mating, nesting, and parental habits of the species were not detailed. What was said was largely hearsay: Chinese farmers had reported finding eggs among the weeds of waste fields during July and August. It has also been claimed that the sun's heat incubates the eggs—if true, a unique method of incubation of crocodilians.

Recently, on the basis of studies carried on in 1957, a Chinese scientist suggested an interesting divergence in the burrow-digging behavior of male and female Chinese alligators. The researcher, Chu Cheng-Kuan, proposed that males are solitary and excavate simple burrows, five feet or more in depth, with a single chamber and two entrances. Females, according to Chu Cheng-Kuan, may hibernate in multi-level complexes, with numerous chambers and entrances, housing several animals.

The Chinese and American alligators inhabit areas with similar climates, as is apparent when monthly rainfall, temperatures, and seasonal changes are compared. Part of the range of both alligators, in fact, lies on the same degree of latitude. Therefore, in attempting to establish environmental conditions suitable for breeding the Chinese alligators, we selected as a model an area along this line of latitude—Jacksonville, Florida. The fact that excellent data are available to us from a local weather station there made the choice even more appropriate.

In March 1964, we built a small experimental nesting box behind the Chinese alligator exhibit. Several inches of sand were placed on the floor of the exhibit enclosure and live plants were added to simulate an inland marsh.

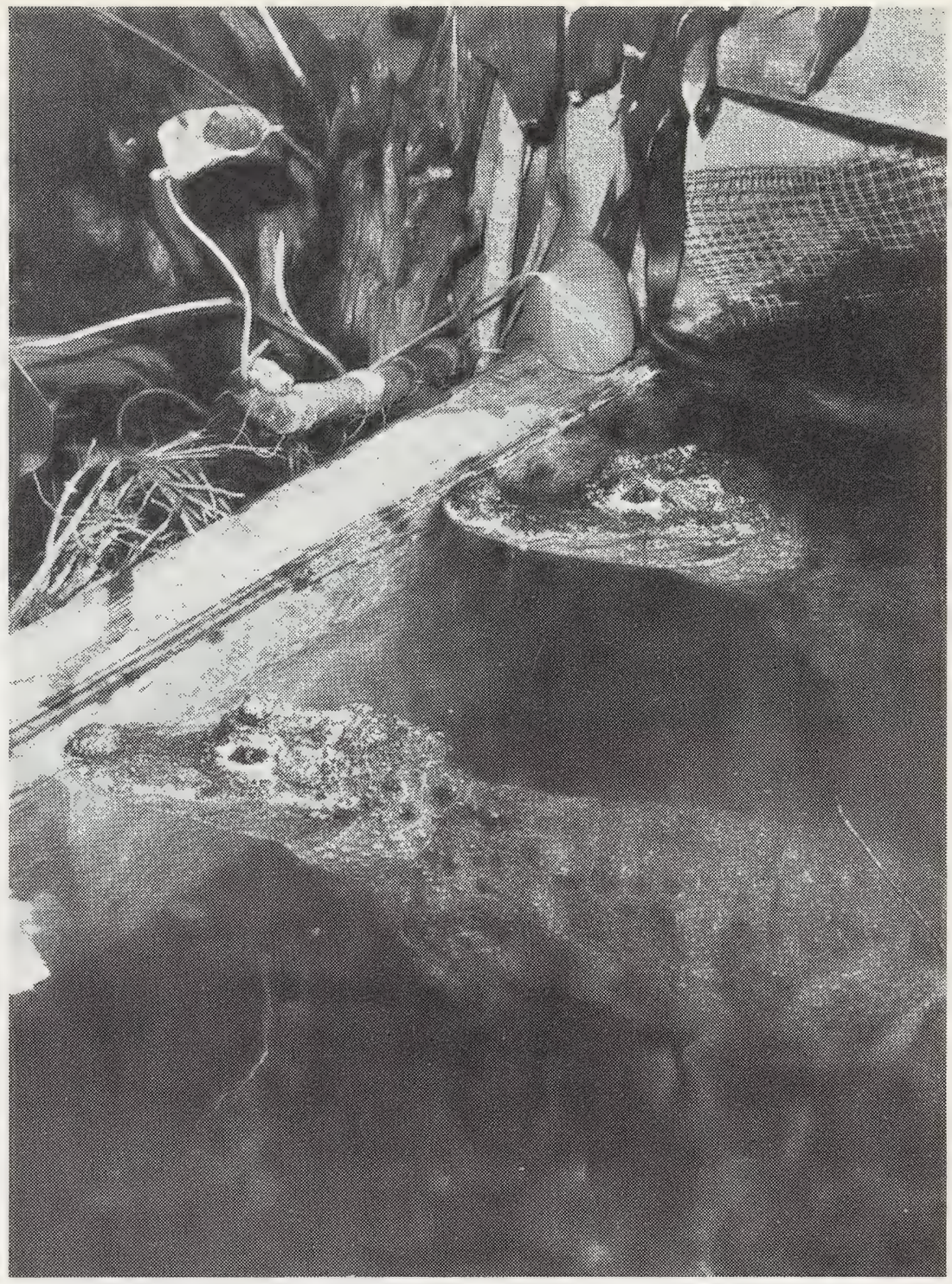
The entire breeding season was assumed to begin soon after March and extend to sometime in June, for once out of hibernation, at least two months had to be considered as sufficient time for the eggs to develop within the female.

With the addition of leaf debris and reeds as nesting material on a rock near the nesting box, a startling change took place in the behavior of the older female. She climbed out of the pool and approached the leaf pile. She seemed to nuzzle the material and began to expel air with a low chuffing sound. Then, with her jaws slightly parted, she took a position on top of the pile. The young female, in her usual manner, climbed onto the adjoining rock area to bask. The old female immediately attacked, lunging savagely at the other animal's every movement. However, she never allowed the lunges to carry her beyond the perimeter of the nesting material. Her tail flicked nervously from side to side as if to announce each charge. Contact meant thrashing and rolling in each other's grip. Fortunately, such encounters lasted only a few moments and did not result in injury, and when the opportunity presented itself the young intruder returned to the safety of the pool.

Shortly afterward, the male also decided the nesting material might be a suitable place to bask. He approached the female and an attack seemed imminent as again her tail began to flick threateningly. She slowly began to advance as the male settled down. Instead of attacking, however, the female gently seized his head in her jaws and began to push him from the material. As he stirred she transferred her grasp to his midbody. A weak bite at the base of the tail made her intentions clear. The nesting material would be hers.

Before the introduction of the nesting material, keepers could easily enter and maintain the enclosure with a minimum of concern. That had changed. I entered the nesting box to examine the substrata and add more nesting material. The old female was well out of sight in the pool at the far end of the enclosure. Suddenly she rushed at me and I was forced to beat a hasty retreat. Since

A Chinese alligator, the legendary T'o.



Male and female in the breeding enclosure pool.

then, the keepers have the greatest respect for the privacy of the lady in her chambers.

In the days that followed claiming of the nesting material, the old female remained on guard, attacking keepers or the other female at their slightest approach. On the third day we moved the nesting material from the rock to the nesting box, visible to the female through the access door. At first we tried to induce her to enter. Finally she seemed to recognize the old material and her chuffing examination became transferred to the nesting area where she often spent her nights.

By March of last year we had developed a new breeding enclosure which included the features found lacking in the earlier one. A wooden pool, larger and deeper than the exhibit enclosure, was placed in position behind it, out of public view. Secluded behind paneled walls and growing plants, the land areas of the new enclosure were divided into two forms—a flat plain of tanbark and leaf mulch, and an area of soil five feet deep, which would provide a suitable place for burrowing. Electrical equipment designed to handle the enclosure's infra-red heaters was placed around the perimeter of the area. Time clocks were used to automatically maintain the required photoperiod. A highly accurate mixing valve delivered water of the proper temperature to the pool. An overhead sprinkler provided the "rains" of the wet season, which seems to trigger the breeding cycle in the wild state.

Unfortunately, the breeding season had passed for the year, and we had also lost the young female. We were now left with the seemingly paired animals of dubious youth. One thing in our favor was the time before the next breeding season in which the individuals could acclimate to their new enclosure. A close relationship had become obvious between the old female and the male. They spent most of their time together. She never did more than gently bite the male to convey some displeasure. They had at times been seen courting and attempting to mate, usually after a series of calls.

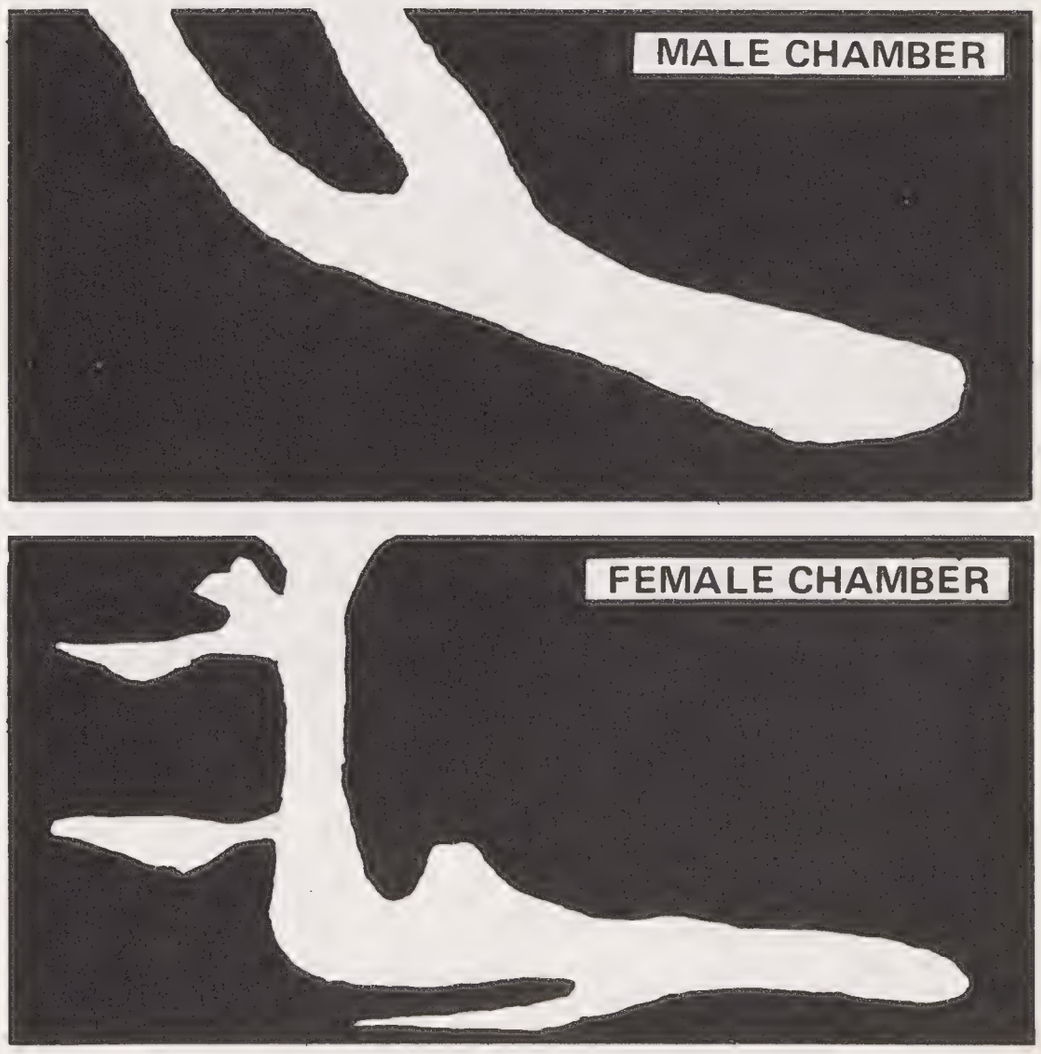
The inactivity of summer passed slowly. Then in the late fall, corresponding to the alligators' dry hibernating season, the water level in the pool was

lowered to a depth of a few inches. Temperatures dropped as the mixing valve was set at 68°F. The alligators' activity lessened. Winter passed and the male was isolated in the adjoining exhibit enclosure. Month by month the photoperiod was adjusted to correspond to the number of day and night hours occuring in the alligators' Chinese range. We waited patiently for the roaring and the explosive calls which seemed to herald the breeding season in previous years. March passed, too, without a sound. April began, and so did the "rainy season." The overhead sprinkler valve was turned on to create "rain" from four to six hours a day. Gradually, both the water level and the temperature mounted. Then on April 12, calling began.

In an enclosure at the other end of the reptile house, the bull American alligator raised his massive head and paused for a moment, as if filling his lungs to capacity. Slowly the roar began. Droplets of water leaped from the surface of the pool over his back, set in motion by the vibrations of his body. As the roar reached its peak, one could feel as well as hear the sound in its magnitude. Before it was ended, another sound could be heard from another direction. Explosive and sharp, the sound "T'o" was repeated in a series over and over again. The Chinese alligators were answering with the same call that had once made men tremble in superstitious fear. We opened the gate separating the male from the female, but the male was reluctant to enter the breeding enclosure. We waited. On the second morning our patience was rewarded, for not only were the alligators together in the breeding pool, but their relationship seemed stronger than ever. Courtship and mating behavior began the following evening.

If breeding is successful, we will have contributed immensely to the knowledge of the life cycle and habits of this rare and endangered species of crocodilian. The principles we will have learned might be applied to the breeding of other species of crocodilians which are known to be approaching extinction.

The older female alligator assumes a defensive position as she guards the nesting material placed in the breeding enclosure.



Chinese scientist Chu Cheng-Kuan has proposed that Chinese alligators excavate burrows as shown above. The solitary male digs a simple burrow with a single chamber and two entrances, while the burrow excavated by the female is more complex with many levels, chambers, and entrances.

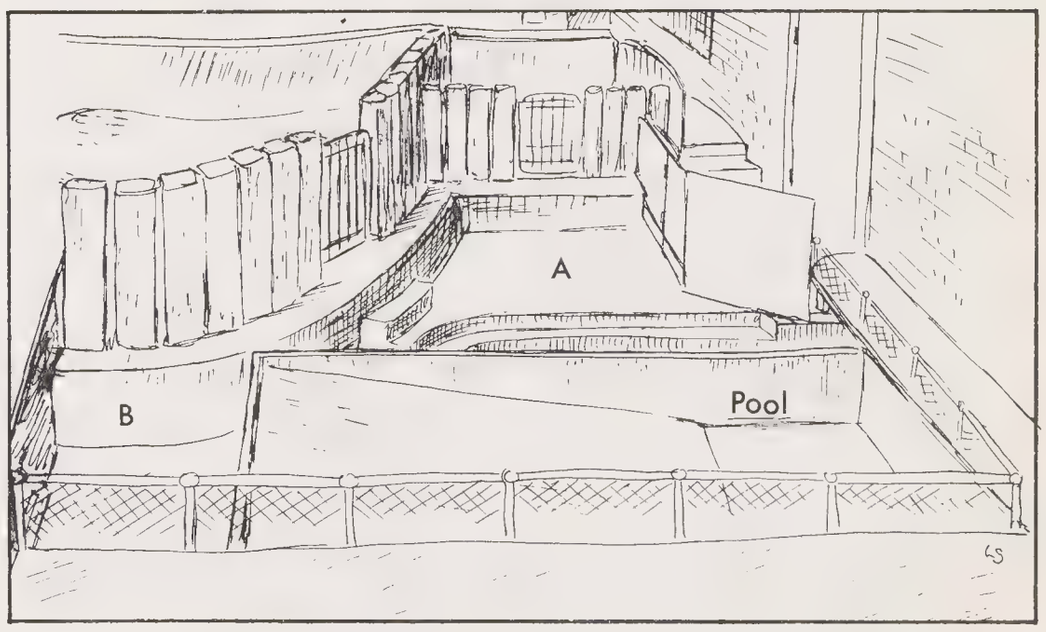
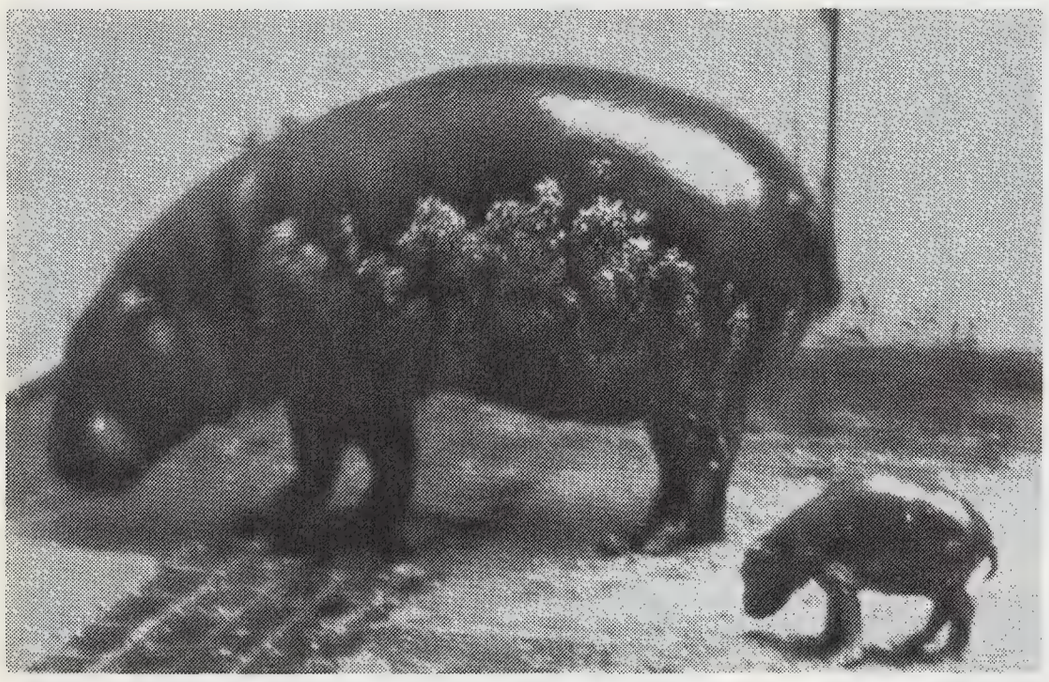


Diagram of the breeding enclosure shows the pool, the flat plain of tanbark and leaf mulch (A), and the burrowing area of deep soil (B).

animal kingdom

NEWS OF ZOOS, AQUARIUMS, AND CONSERVATION

REPORTS



A male pigmy hippopotamus born at the Brookfield Zoo (Illinois) is on exhibit with his mother, "Sassy."

Pigmy Hippopotamus Born at Brookfield

Brookfield Zoo recorded its first birth of a pigmy hippopotamus October 11, when the zoo's female, "Sassy," gave birth to a male calf.

The youngster and mother are on exhibit in the zoo's pachyderm building. At birth the calf weighed 15 pounds. By the month's end, according to Dr. George B. Rabb, associate director at Brookfield, the young hippo had gained seven pounds.

"Sassy," slightly more than five years old, came to the Brookfield Zoo from the Copenhagen Zoo in April 1964. "Spunky," the male parent of Brookfield's new youngster, was obtained from an animal dealer in Holland in 1963 at an estimated age of six months.

The pigmy hippopotamus, *Choeropsis liberiensis*, is classified as a rare and endangered species by the International Union for Conservation of Nature and Natural Resources.

Queens Zoo

A new zoo, in Queens, New York City, opened to the public October 26 at Flushing Meadow-Corona Park, the site of two World's Fairs. The Queens Zoo, which covers 18 acres, features exhibits of North American animals. It is operated by the Triborough Bridge and Tunnel Authority.

Milwaukee and the Bronx — Grevy's Zebras

Grevy's zebras have been born at the Milwaukee Zoo and the Bronx Zoo. Milwaukee's Grevy's, a male, was born September 19. The Bronx Zoo's zebra, a female, arrived October 6.

The Grevy's zebra *(Equus grevyi)* is the largest zebra and is considered the most striking of its kind. This zebra is native to southern Ethiopia and northern Kenya.

Big Bears Exhibit Opened

A new zoo exhibit where the world's largest terrestrial carnivores — and the runners-up — roam a natural landscape free of visible barriers opened to the public October 4 at the Bronx Zoo.

The zoo's new Big Bears Exhibit houses polar bears and Kodiak bears, the latter a form of brown bear found only on the Alaskan island that gives them their name. The Kodiak bear, which may weigh more than 1,500 pounds when adult, is unmatched for sheer power and size by any other meat-eating land animal. Polar bears, while not as

big as the Kodiaks, sometimes weigh more than a thousand pounds.

The exhibit has two polar bears, both females, and six Kodiak bears, three males and three females. Three of the Kodiaks are from the Cleveland Zoo, two from the Houston Zoo, and one from the Pittsburgh Zoo. The two species are in separate areas. The bears in the exhibit are immature: all are about two years old. Polar bears and Kodiak bears are fully grown at about five or six years of age.

Visitors view the bears across a hidden moat 13 feet deep and 15 feet wide. Zoo-goers also can enter a "cave" where cut-away windows permit a view of the interior of a Kodiak bear den. If, as hoped, the animals breed in the exhibit, the windows will allow visitors to watch mother and cubs at home during the early stages of the cubs' development.

The exhibit consists of two outdoor areas divided by a spine of rock, both natural and imitation, which forms a den and cliff complex. The imitation rock conceals the exhibit building, honeycombed with service corridors, work areas, and ten bear dens, which open on the outdoors.

A watercourse meanders through the western side of the exhibit, which contains the Kodiak bears. Red foxes, found in the Kodiak bears' natural environment, share this area with the great brown bears.

The eastern side of the exhibit, for polar bears, has a large pool, more than 6 feet deep, 50 feet long, and 30 feet wide. It is fed by a waterfall that cascades from a cliff top.

Ecuadorian Expedition

The first animal-collecting expedition sponsored by the Zoological Society of Florida has returned from Ecuador with a large number of animals for the Crandon Park Zoo in Miami. According to Jack Hamilton, the zoo's curator of reptiles, he and Zookeeper Peter Terry were successful in collecting several reptiles in the wild and in obtaining many rare birds for exhibit.

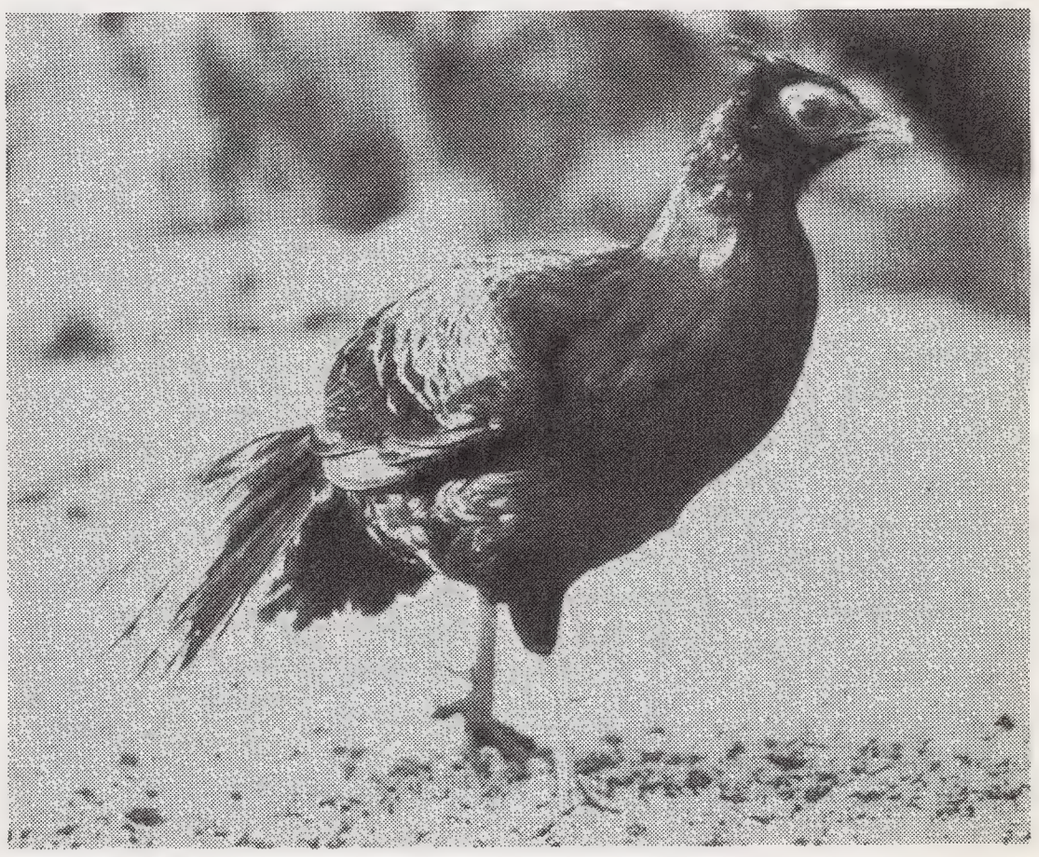
While on the expedition, the Florida zoo men conducted preliminary negotiations with the Ecuadorian government to obtain Galapagos tortoises. These would be added to the zoo's existing collection of giant tortoises in the hope of breeding the rare animal.

Death of Walter Stone

Walter D. Stone, director of the Franklin Park Zoo in Boston and the Middlesex Fells Zoo, Stoneham, Massachusetts, died September 24, 1968, in an automobile accident in Londonderry, New Hampshire.

Mr. Stone, a past president of the American Association of Zoological Parks and Aquariums, had been at the Franklin Park Zoo for almost a decade. Prior to that he was with the Detroit Zoo and the Audubon Park Zoo in New Orleans.

Mr. Stone is survived by his wife, Elizabeth, and nine children. He was 42.



Imperial pheasant ***(Lophura imperialis)*****.**

Last of a Long Line

The last imperial pheasant, as far is known, in an American zoo died at the Bronx Zoo on August 20, 1968. The pheasant, a male, was the survivor of a pair that arrived at the zoo in 1947; the female died in 1964.

A very rare species, the imperial pheasant *(Lophura imperialis)* was discovered in Annam, the eastern region of Indo-China, in 1923 when one pair was sent alive to Jean Delacour's expedition by two missionaries from the rugged limestone mountain area of Dong Hoi and North Quangtri. According to Delacour, the original pair is the only one that has ever been collected in the wilds. Brought to France, the pair started breeding in Cleres in 1925. Continued successful breeding of the pair and offspring for several years enabled several zoos around the world to exhibit this rare and handsome species.

Seals Settle Off California Coast

A breeding colony of northern fur seals *(Callorhinus ursinus)* has been discovered on San Miguel Island off the coast of California. The report of this discovery was made by Richard S. Peterson and Burney J. LeBoeuf of the University of California at Santa Cruz, and Robert L. Delong of the Pacific Ocean Biological Survey Program, Smithsonian Institution, in a recent issue of the British journal, *Nature.*

The new colony consists of one adult male, approximately 60 females, and 40 young, including newborn pups. It is not known why the seals have chosen this particular island, which they share with rookeries of California sea lions and elephant seals, nor whether they are reclaiming a former breeding ground or establishing a new one.

Heretofore the northern fur seal has not been known to breed anywhere in the world but on the Pribilof Islands off Alaska and a few other islands in the Bering and Okhotsk Seas.

Once hunted almost to extinction, the fur seal is now protected by international treaty which has enabled its world population to increase to about two million. The report ends with the expressed hope that the San Miguel colony of fur seals will be granted full protection to insure its continuance for both breeding and study.

Animal Health Warning

Wild animals bearing disease could cause havoc with the nation's multi-billion dollar livestock industry and pose numerous health hazards to man. This was the warning given by scientists attending the meeting of the Pan American Health Organization and the Conference of Public Health Veterinarians in August at San Antonio, Texas.

Wildlife disease expert Dr. Frank Hayes of the University of Georgia raised the possibility of accidental introduction of numerous virulent diseases, including rabies, foot-and-mouth-disease, and a host of others. He called for continued rigid inspection procedures and adequate quarantine facilities to minimize risks associated with the movement of wild animals.

However, the greatest health hazards were not posed by zoo animals, participants were told by Dr. Leonard J. Goss, director of the Cleveland Zoological Park.

"The small number of zoo animals imported into a country is in sharp contrast to the thousands of mammals and birds imported for the pet shop trade or research purposes," he said.

Dr. Claude Smith of the Import-Export Animals and Products Division of the Department of Agriculture said that animal diseases recognized no national boundaries. He stressed the close cooperation needed between animal health officials in the countries of origin and destination.

Killer Whale Dies

Lupa, the killer whale, who was introduced to readers of *Animal Kingdom* this past April, was found dead in her pool at the New York Aquarium at Coney Island on the afternoon of September 6.

One of the largest whales in captivity — measuring 18-feet long and weighing almost 5,800 pounds — she died minutes before Robert Morris, curator of the aquarium, lowered the water in the pool preparatory to taking a blood sample. Accustomed to a daily diet of 180 pounds of frozen mackerel and herring, Lupa had not been feeding well for several days.

The result of the autopsy performed by Dr. Jay Hyman, the aquarium's consulting veterinarian, disclosed that Lupa had died of a "long-standing infection" of her lungs.

Lupa's skull was given to the American Museum of Natural History and her brain to the Osborn Laboratories of Marine Sciences.

A black jaguar cub named "Hermann," shown here with his mother, is now on exhibition in the Lion House at the Philadelphia Zoo. He is the first black jaguar to be born at the zoo.

THE bookshelf

A FIELD GUIDE TO THE MAMMALS OF BRITAIN AND EUROPE. *By F. H. van den Brink. Illus. by Paul Barruel. 20 plates in color, 12 in black-and-white. 221 pages. Houghton Mifflin Co., Boston, 1968. $7.50.*

As one of the Peterson Field Guide Series, edited by Roger Tory Peterson, this small volume fills a gap of long standing. First published in Holland in 1955, it was translated from the Dutch into English by Hans Kruuk and H. N. Southern and issued in 1967 by William Collins Sons & Co., Ltd., London and Glasgow, and Houghton Mifflin Co., Boston. Now presented as an American edition, the style of the book follows closely that of others in the Peterson series and it will be welcomed by nature-minded American travelers in Europe.

As pointed out by Roger Peterson in an editor's note, a very large proportion of mammals are nocturnal and seldom seen. Nevertheless, with the aid of Mr. Barruel's excellent illustrations, many drawings of footprints, and numerous distribution maps, more than 200 species could be distinguished if seen or at least their presence could be noted.

The formulation of such a book was a difficult task, for many countries and languages are involved in the literature of the subject. Even though technical names are confined to the species level, agreement on a middle ground satisfactory to all would seem almost impossible. Nevertheless, with the aid of a glossary and a rather extensive section devoted to taxonomic notes, this seems to have been accomplished and this most useful guide has resulted. L. S. C.

A FIELD GUIDE TO THE BIRDS. *Text and illustrations by Roger Tory Peterson. Second Revised and Enlarged Edition. 1000 illustrations, 500 in full color. 290 pages. Houghton Mifflin Co., Boston, 1968. Paperback, $2.95.*

Very little need be added in the way of praise for this small volume. Popularly known as the "bible" for bird watchers, the fact that it is now in its thirty-fifth printing is ample proof of its value as a quick and informative reference for identifying the birds of eastern North America. The present edition is in paperback. J. Bell

ANIMAL VISION. *By George F. Mason. 80 pp. William Morrow and Co., Inc., New York, 1968. $2.95.*

This young people's book—written and illustrated by the author of numerous books on natural history—is a sound little guide to the physiology of vision. It is also chock-full of textbook "isms" such as "let us first consider." Also, one wonders if youngsters of the age to which this book is addressed are not rebuffed by such prose as: "Anglers, particularly the dry-fly purists and plug fishermen, believe that the colors of their flies and plugs are very important." Or: "Several photochemical substances play a part in the light sensitive mechanisms of the retina." This is a book for a youngster already intensely interested in zoology but it might well be drudgery for a young reader with only a casual curiosity about how living creatures see. E. R.

INSTINCT AND INTELLIGENCE, BEHAVIOR OF ANIMALS AND MAN. *By S. A. Barnett. 320 pp. Prentice-Hall, Inc., Englewood Cliffs, N.J., 1967. $6.95.*

During the past three years there has been a flood of books on animal behavior. They range from highly technical monographs, intelligible only to the student or professional investigator, to popular accounts of the more dramatic and stimulating ideas that have come from this active field of research during the past 20 years. Barnett attempts with considerable success to strike a happy medium. He draws upon a broad and thorough knowledge of both experimental psychology and ethology, that is, the study of animal behavior from the viewpoint of zoologists. He also has the ability to summarize in pithy fashion large areas of knowledge or of controversy. Major topics lucidly surveyed include movements of animals, searching and exploration, herding, courtship and family relations, communication and animal societies, the complex and often conflicting ideas

surrounding the terms "instinct," "drive," and "intelligence," and finally the relationships between animal and human behavior.

Barnett basically takes the hard-boiled position of behavioral scientists who shun vague, diffuse, or anthropomorphic concepts. He is unhappy with such terms as "voluntary," "instinct," "intelligence," "emotion," or "consciousness." But unlike most behavioral scientists of the 20th century he does not ignore the phenomena which these and similar terms represent to ordinary people. Even the most rigorous scientist is tempted to use these terms in spite of theoretical reluctance. Barnett's book is the more valuable because he has the courage to come to grips with these questions and because he does so in clear and straightforward words. Regardless of one's own inclinations in these matters, it is possible to appreciate from this book what various types of behavioral scientists believe, and why.

Having attempted so difficult an enterprise, it is not surprising to find a few questionable sections of the book. For example, most readers of *Animal Kingdom* will prefer photographs of flying animals right side up, rather than rotated 90° because, apparently, some designer preferred the resulting composition. Although the important communication dances of honeybees are quite adequately described, the erroneous statement is made elsewhere that "the hive bee does not use scent marks"; such marks are used under special circumstances to supplement the information conveyed by the dances. Invertebrate zoologists will be especially surprised to read that "A jellyfish or a marine larva responds in the same way however often a stimulus is presented."

Elsewhere Barnett accurately reflects a large body of contemporary scientific opinion when he writes "the only rational policy is to describe what we observe and if that entails giving up colloquial terms such as hunger then we must resign ourselves to doing without them." From a broader viewpoint, readers may well wonder why Barnett and so many other scientists feel impelled to abandon general overall terms like "hunger" or "inherited" simply because detailed, though still incomplete, analyses of underlying mechanisms show these to be complex. For example it is customary to speak of "the respiratory center" in a mammalian brain, but on close physiological analysis it turns out that many parts of the brain are importantly involved in controlling ventilation of the lungs. This, however, does not banish words like "breathing" and "respiration" from the vocabularies of physiologists. Barnett argues that the word "inherited" should not be applied to any behavior patterns, because both genetic and environmental influences clearly interact to varying degrees to influence behavior. Similar statements can be made about many anatomical characters of animals and men. But geneticists did not stop studying genes simply because they learned that many features of adult animals can also be affected by environmental influences.

These comments may well serve to stimulate more readers to pay attention to Barnett's book and the ferment of ideas it competently summarizes. Even the author, I suspect, would agree that final answers to these basic questions are still sufficiently remote to leave ample scope for differences of vocabulary, interpretation, and opinion.

D. R. Griffin

ABOUT THE authors

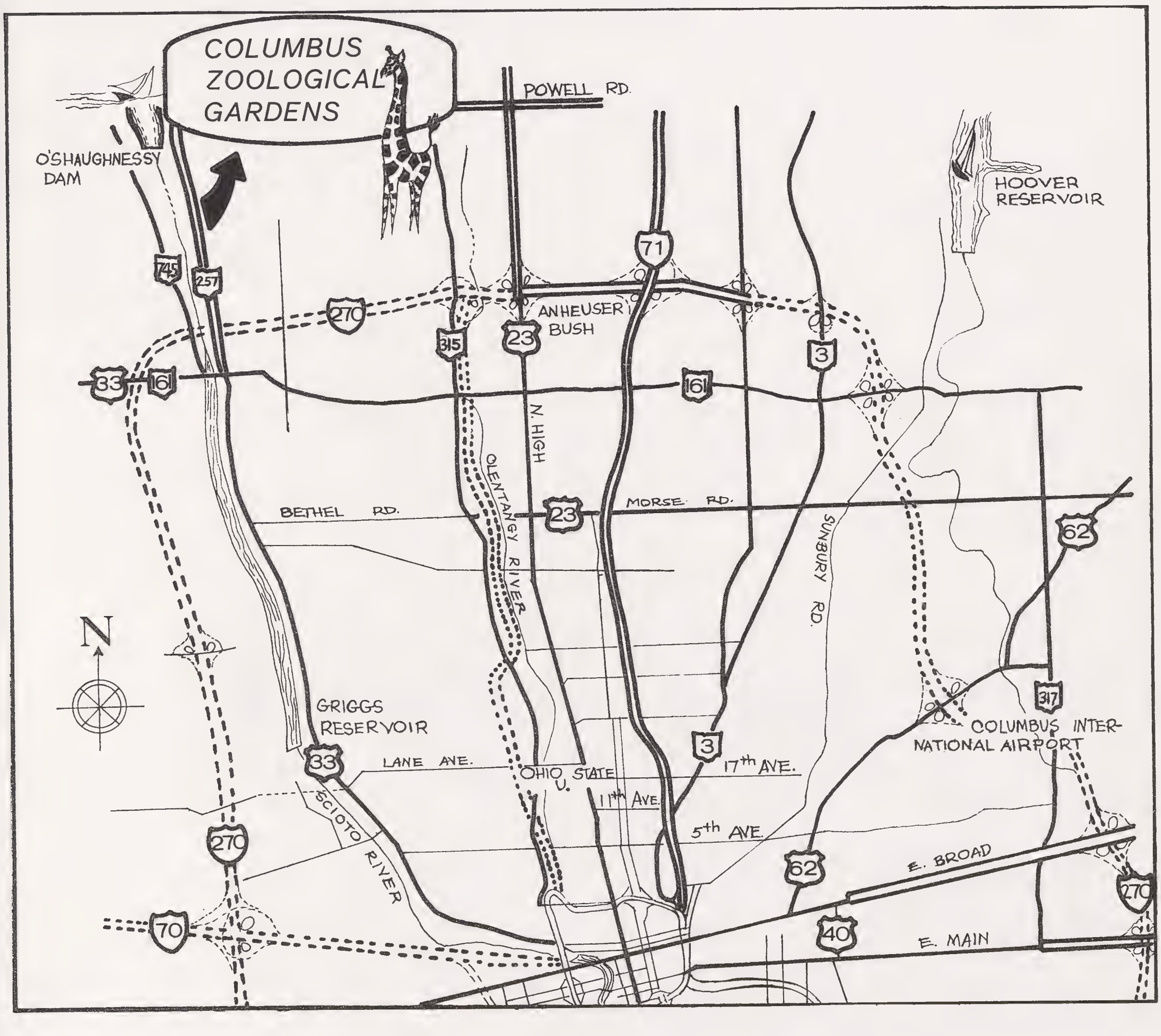
Peter Brazaitis is assistant animal manager in the Bronx Zoo's Department of Herpetology. **Joseph A. Davis, Jr.,** is scientific assistant to the director of the New York Zoological Park. **Stan Federman** is a journalist in Portland, Oregon. **David Hancock** is director of the Island View Wildlife Research Centre, Saanichton, B.C., Canada. **Paul G. Kovac,** a member of the New York Zoological Society, is a New Yorker who has gained recognition for his animal photographs.

ILLUSTRATION CREDITS

Cover: David Hancock; pp. 2, 4, 5, 7: N.Y.Z.S.; pp. 9-13: David and Lyn Hancock; pp. 14-17: Paul G. Kovac; pp. 18-23: David Falconer; p. 24: China Institute in America; pp. 26, 27, 28, 29: N.Y.Z.S.; p. 30: Zoological Society of Philadelphia; Back Cover: N.Y.Z.S., James Simon.

VISITING COLUMBUS, OHIO?

The Columbus Zoological Gardens, founded in 1925, covers 92 acres and exhibits 2,600 animals. Colorful educational displays in each animal building supplement the live exhibits. The zoo is open daily from 10 A.M. to 6 P.M. Admission is 50c (under 12 years of age, free), and parking is free.



This is one in a series of travel guides to zoos and aquariums presented by ANIMAL KINGDOM as a service to its readers. We welcome submission of maps and information to be used on this page.

SMITHSONIAN
JAN
LIBRARIES

90.673
S5

animal kingdom

VOL. LXI, NO. 6, DEC., 1968

MAR 14 1969

NEW YORK ZOOLOGICAL SOCIETY
The Zoological Park, Bronx, N. Y. 10460

Laurance S. Rockefeller
President

Fairfield Osborn
Chairman of the Board of Trustees

Robert G. Goelet
Executive Vice-President and Chairman of the Executive Committee

Henry Clay Frick, II
Vice-President

John Pierrepont
Treasurer

Howard Phipps, Jr.
Secretary

Eben W. Pyne
Assistant Treasurer

Harold C. Palmer
Assistant Secretary

BOARD OF TRUSTEES
(Executive Committee)*
Alexander Aldrich, George F. Baker, Jr.*, Robert E. Blum, Guy F. Cary, William R. Coe, C. Suydam Cutting, John Elliott, Charles W. Engelhard, Henry Clay Frick, II*, Robert I. Gannon, Peter R. Gimbel*, Robert G. Goelet*, Peter Grimm, John N. Irwin, II*, Warren Kinney, Anthony D. Marshall, Otto Marx, Jr., David Hunter McAlpin*, Peter Matthiessen, G. W. Merck, Charles W. Nichols, Jr.*, Fairfield Osborn*, Augustus G. Paine, II, Howard Phipps, Jr.*, John H. Phipps, John Pierrepont*, Eben W. Pyne, Laurance S. Rockefeller*, David T. Schiff, John M. Schiff, Henry Sears, Chauncey Stillman, Joseph A. Thomas, Landon K. Thorne, Jr., Alfred G. Vanderbilt, Robert Winthrop

Ex-Officio:
The Mayor of the City of New York
Hon. John V. Lindsay

Administrator of Recreation and Cultural Affairs
August Heckscher*

General Director
William G. Conway

ZOOLOGICAL PARK
William G. Conway, *Director & Curator, Ornithology;* Charles P. Gandal, *Veterinarian;* Hugh B. House, *Curator & Chairman, Mammalogy;* Grace Davall, *Assistant Curator, Mammals & Birds;* James C. Doherty, *Mammalogist;* Joseph Bell, *Associate Curator, Ornithology;* Donald F. Bruning, *Ornithologist;* F. Wayne King, *Curator, Herpetology;* Herbert J. Knobloch, *Curator, Education;* Charles B. Driscoll, *Superintendent, Operations;* Edward Kearney, *Manager, Facilities Dept.;* Joseph A. Davis, Jr., *Scientific Assistant to the Director;* Lee S. Crandall, *Zoological Park Consultant & General Curator Emeritus;* William Bridges, *Curator of Publications Emeritus;* Roland Lindemann, *Consultant, Mammal Management;* John M. Budinger, *Consultant, Pathology;* Ben Sheffy, *Consultant, Nutrition*

AQUARIUM
Ross F. Nigrelli, *Director;* Nixon Griffis, *Administrative Assistant to the Director;* Robert A. Morris, *Curator;* U. Erich Friese, *Assistant Curator;* Lars Mellkvist, *Superintendent;* Jewell Bungay, *Business Manager;* Louis Mowbray, *Research Associate, Field Biology;* Christopher W. Coates, *Director Emeritus*

OSBORN LABORATORIES OF MARINE SCIENCES
Ross F. Nigrelli, *Director;* Martin F. Stempien, Jr., *Assistant to the Director;* George D. Ruggieri, S.J., *Coordinator of Research;* William Antopol, C. M. Breder, Jr., Jack T. Cecil, Harry A. Charipper, Kenneth Gold, Myron Jacobs, Klaus Kallman, Vincent Liguori, John J. A. McLaughlin, Martin P. Schreibman, Eva K. Hawkins

INSTITUTE FOR RESEARCH IN ANIMAL BEHAVIOR
(Operated jointly by the Society & Rockefeller University)
Donald R. Griffin, *Director;* Peter R. Marler, Jocelyn Crane, Roger S. Payne, Richard L. Penney, Fernando Nottebohm, George Schaller, Thomas T. Struhsaker, C. Alan Lill

WILLIAM BEEBE TROPICAL RESEARCH STATION
O. Marcus Buchanan, *Resident Director*

GENERAL
Walter Lerchenfeld, *Comptroller;* Bernard M. Fagan, *Accounting Manager;* John McKew, *Personnel Manager & Assistant to the Director, Zoological Park;* Gordon Cuyler, *Membership Chairman & Administrative Associate;* Jerry M. Johnson, *Curator, Department of Exhibition and Graphic Arts;* Edward R. Ricciuti, *Editor & Curator, Publications and Public Relations;* Joan Van Haasteren, *Editorial Assistant;* Dorothy Reville, *Photo Librarian;* Sam Dunton, *Photographer*

AFFILIATE
Jackson Hole Biological Research Station
L. Floyd Clarke, *Director*

ANIMAL KINGDOM STAFF
Edward R. Ricciuti Editor and Curator, Publications and Public Relations
Joan Van Haasteren Editorial Assistant
Jerry M. Johnson Curator of Exhibition and Graphic Arts
Barbara Lee Syvertson Graphic Designer
Dorothy Reville Photo Librarian
Sam Dunton Photographer
William Meng Photographer

animal kingdom

MAGAZINE OF THE NEW YORK ZOOLOGICAL SOCIETY VOL. LXXI NO. 6 DECEMBER, 1968

SMITHSONIAN
MAR 1 - 1969
LIBRARIES

ABOUT THE COVER

Front: Red Kite *(Milvus milvus).* The birds of prey include some of the world's most regal and fascinating birds. Not long ago photographer William Meng (and scores of amateur lensmen) made the most of a rather unusual opportunity to photograph several different species of birds of prey. The occasion was a demonstration of falconry. Its purpose: to stir public interest in preserving threatened birds of prey. (See page 13.)

Back: Climbing toad *(Pedostibes hosei)* of Southeast Asia climbs very well with the aid of large toe pads; only the females (as here) are spotted.

CONTENTS

Wilderness Island in Megalopolis —
THE PINE BARRENS 2
by Robert Brandner

RIVER OTTERS, SEA OTTERS, AND PART-TIME OTTERS
Part II 8
by Joseph A. Davis, Jr.

CLOSE-UP ON THE BIRDS OF PREY 13
Photographs by William Meng

ANT ARMIES OF TROPICAL AMERICA 16
by Antony Gahan

"So Remorseless a Havoc"
CAN THE GREAT WHALES SURVIVE? 22
by Edward Edelson

ANIMAL KINGDOM REPORTS 27

THE BOOKSHELF 29

ILLUSTRATION CREDITS 30

ABOUT THE AUTHORS 30

CONTENTS 1968 31

INDEX 1968 32

ANIMAL KINGDOM purchases first North American serial rights for articles, photographs and drawings. Payment is made on articles accepted for publication subject to editing and revision when necessary. ANIMAL KINGDOM is not responsible for the return of unsolicited material. Opinions expressed in signed articles are not necessarily those of the New York Zoological Society.

Issued bi-monthly by the New York Zoological Society at the Zoological Park, Bronx, N. Y. 10460. Editorial and Subscription Offices at the same address. Title registered with the U. S. Patent Office. Subscription, $3.50 a year; single copy, 60 cents. Same rates for all foreign countries and Canada. Second-class postage paid at Bronx, N. Y. Send Form 3579 to Bronx, N. Y. 10460.

©1968 New York Zoological Society. All rights reserved.

wilderness island in megalopolis

The Pine Barrens

BY ROBERT BRANDNER

Although dubbed the "Garden State," New Jersey would seem to be the embodiment of over-urbanized America, rather than a land of greenery. Much about New Jersey, at least, gives this impression.

The state, the fourth smallest in area, has more people per acre than any other in the Union; it has lots of look-alike housing, standing cheek-by-jowl on land swept clean of trees. Unattractive industrial complexes flank long stretches of the New Jersey Turnpike, which forms a northeast-southwest corridor across the state. At opposite ends of this corridor, the metropolitan areas of New York City and Philadelphia spill over into catercorner chunks of New Jersey, threatening to pinch the state in two at its narrow waist.

Yet—and this surprises many people who see only urban New Jersey—more than 70 percent of the state is taken up not

by row housing and chemical plants but by farm and forest. New Jersey, in fact, claims the largest slice of wildland in the Middle Atlantic Seaboard: the famed Pine Barrens, some 2,000 square miles (1,164,000 acres to be precise) of coniferous (pine-oak) forest that constitutes one of the most unique ecological situations in eastern North America.

The margins of the Pine Barrens, ironically, sprawl to within 25 miles of Philadelphia and 35 miles of New York. The pines begin just southeast of the corridor between these two metropolises and stretch from there almost to the sea. Starting in the southern portion of Monmouth County, they cover most of Ocean and Atlantic Counties, huge expanses of Burlington County, and spill over into large areas of Camden, Gloucester, Cumberland, and Cape May Counties. A small area of Salem County is also included.

The unusual environment and geographical location of the Pine Barrens provide a haven for many unusual and interesting plants and animals. Southern forms that have their most northern distribution overlap with northern forms having their most southern distribution, thus forming a large and diverse population of wildlife.

Over the years millions of tourists driving along the Garden State Parkway or Route 9, heading for any of the many New Jersey shore resorts, have passed through parts of this ecologically unique area without realizing it.

From the deciduous forest of dark soils, with its oak, maple, beech, and elm trees, from the open grassy meadows and the mountainous terrain of the north, there is an almost abrupt change to the low, almost flat, white sandy soil covered by coniferous forest, with its dominate trees of pitch pine, shortleaf pine, and blackjack oak. Dry and desolate, with many of the trees scarred by recent fires, it appears to be useless wasteland. It is not until one leaves the highway and travels farther into the area that the true Pine Barrens reveal themselves in a clearer and kinder light.

Fire is one of the main factors that make the Barrens what they are. The plant life is highly inflammable, capable of burning quickly with intense heat. However, the underground sections sprout in profusion within days after the fire has died. Larger pitch and shortleaf pine produce new growth from the large limbs. The younger trees produce sprouts from the base of the trunk, replacing the original tree with one or more trees from the root system of the old. Oak trees in all sizes also possess the ability to sprout from the base of the trunk; however, frequent burning

New sprouts grow from the base of a charred tree; thus the forest renews itself after burning.

EDITORIAL: WORTH SAVING

The Pine Barrens of New Jersey are saddled with an unfortunate name. The Barrens, as Robert Brandner shows in the accompanying article, are not at all "barren." That they should be called by such a name reflects a self-centeredness that too often colors the outlook of humankind when it comes to nature; a view consistent with typical "development" language which substitutes "wastelands" for swamps and marshes and, in New York City, garbage dumps for parks! Apparently the Pine Barrens are so called because of their limited agricultural potential but they teem with life. The Barrens embrace a panoply of wild animals and plants unique in the nation's northeastern quadrant.

For several years this wilderness and its wildlife have been threatened with devastation. Periodically there are demands that vast stretches of the pines be buried under the concrete and asphalt of a jetport for the New York Metropolitan area. The most recent such effort subsided in October. For technical reasons, the Port of New York Authority and several airlines scotched this latest attempt — much to the outrage of New Jersey Governor Richard J. Hughes' jetport committee.

The National Park Service is now considering whether the federal government should take a hand in preserving the Pine Barrens. The outlook is encouraging, but the situation is fluid. Unless action is taken soon to safeguard the Pine Barrens, another irreplaceable piece of our natural heritage will be lost forever.

seems to lessen the oak's ability to spring back, and some forms die and do not replace themselves in areas that often burn. Blackjack oak and possibly the post oak appear to be the only oaks that thrive under these conditions.

Spotted throughout the low swampy areas and stream banks are large tracts of southern white cedar mingled with swamp magnolia. Between the swamps and pine forest, there is often a fringe area of red maple, sour gum, and gray birch trees.

The undergrowth of the Barrens is rich with lush shrubs, blueberries, chokeberries, Virginia creeper, buttonbush, and dwarf sumac.

The plants of the Barrens are also of great interest, numbering over 130 species. Some forms are extremely rare, two of which are known only from the Pine Barrens: the sand myrtle, *Leiophyllum buxifolium*, and the pickering morning glory, *Breweria pickeringi* var. *caesariensis*. Other plants whose original description was from the Barrens are: beaked rush, *Rhynchospora knieskerni;* Long's wool grass, *Scirpus longii;* broom-crowberry, *Cormema conradii;* golden aster, *Chrysopsis falcata;* Pine Barrens reed grass, *Calamovifa brevipilis;* Torrey's muhly, *Muhlenbergia torreyana;* Hirst's panic grass, *Panicum hirstii;* pineland millet grass, *Amphicarpum purshi;* slender beaked rush, *Rhynchospora gracilenta;* slender nut rush, *Scleria minor;* New Jersey rush, *Juncus caesariensis;* bog asphodel, *Narthecium americanum;* golden crest, *Lophiola americana;* southern yellow orchis, *Habenaria integra*, grass-leaved ladies' tresses, *Spiranthes laciniatra;* begger's ticks, *Desmodium strictum;* bush clover, *Lespedeza hirta* var. *longifolia;* short-leaved milkwort, *Polygala brevifolia;* meadow beauty, *Rhexia aristosa;* Canby's lobelia, *Lobelia canbyi;* sticky boneset, *Eupatorium resinosum;* and curly grass fern, *Schizea pusilla.*

Another extremely rare species is the turkey beard, *Xerophyllum asphodeliodes*, whose northern-most range extends into the Barrens. (This list of plants is from McCormick, *Pine Barrens of New Jersey*, 1967.)

The vegetation of the Pine Barrens is a relict population existing now much as it did during the Miocene Period 25 million to 10 million years ago. For most of this period, the Pine Barrens were surrounded by the sea, cut off from the mainland and unaffected by its influence, allowing the native plants and some of the animals to become an ecological system independent of the surrounding land area.

Like the plant life, many animals of the region overlap, due to the northern-most range of many southern forms, producing a diverse and interesting population. In some cases, species rare throughout their range are abundant in the Barrens, and in one case an endemic form exists.

The very structure of the Barrens—topography, acidic water, vegetation, and soil—dictates to a large degree the animals found there.

The insects are a very important link in the chain of life; many forms feeding on the vegetation of the area are in turn eaten by amphibians, reptiles, birds, fish, mammals, and other insects. These predators are in turn eaten by larger specimens of the various predatory groups.

Although the insects of the area have a tendency to be grouped with the more southern forms, only two forms are considered rare or restricted to the Pine Barrens and are not found in other parts of the state: the post oak locust, *Dendrotettix quercus*, a wingless grasshopper that feeds on the deciduous shrubs and plants of the area; and the leaf-cutting ant, *Atta septentrionalis*, which feeds on fungi grown on plant material which it brings underground.

The Pine Barrens are poor in bird life. Most of the population consists of transients or breeding populations, with only approximately 30 permanent resident species. This is due to the dominate, relatively low, pine forest, and the lack of variety of foods and nesting sites, which also contribute to the tendency of migrating birds to by-pass the area. Some of the more interesting birds breeding in the area are the turkey vulture, red-tailed hawk, whippoorwill, green heron, wood duck, Traill's flycatcher, purple martin, rough-winged and barn swallows, tufted titmouse, and Carolina chickadee. During the year approximately 130 species of birds may be observed.

The mammals of the area are now reduced to the smaller, less conspicuous species; however, the area still has a varied and interesting population. The puma (sometimes called panther or mountain lion), wolf, black bear, and bobcat are now long extinct in the area, and leave the white-tailed deer the only large animal to represent the once-great mammal population. Due to the lack of predators, this herbiferous species has grown in number to a population much larger than in the time before man settled the area. Good conservation practices and proper hunting regulations hold the deer population in check, thereby eliminating the chances of overbrowsing and possible mass starvation during the winter.

Other species found in the Barrens or along the fringe are the gray fox, rabbit, opossum, skunk, weasel, raccoon, woodchuck, gray, red and flying

squirrels, several species of mice, bog lemming, several shrews, hoary bat, common mole, star-nosed mole, and occasionally the river otter along Pine Barrens streams.

One species in particular is an endemic form: the New Jersey wood vole, or red back mouse, *Clethrionomys gapperi rhoadsi*. This is the only species of mammal entirely dependent on the Pine Barrens. Its entire range is within this region and it is truly New Jersey's own.

This species has a body length of approximately four inches and a tail length of one-and-a-half inches. It is dark chestnut above, with black hairs densely mingled over the dorsal surface, and the underpart, grayish in color, is separated from the dorsal surface along the ground line.

The New Jersey wood vole, or red back mouse (above), is entirely dependent on the Pine Barrens; its entire range is within this region and destruction of the habitat would mean its extinction. The carpenter frog (right), restricted to water with a high acidic content, is abundant in the Barrens but is considered uncommon elsewhere throughout its range.

Unable to withstand the high temperatures of the Pine Barrens in summer, the wood vole is restricted in habitat to the dense cedar swamps where the overhead foliage, underground springs, and dense damp sphagnum moss of the substrate provide the cool temperatures needed by this species. Destruction of the habitat would mean its sure extinction.

The area draws a certain amount of interest from the sports fisherman and fish fancier. The slow-moving warm streams, lakes, and cranberry bogs contain a small but respectable amount of game fish. They bring sportsmen down to try their luck at catching redfin and chain pickerel, small-mouth bass, redbreasted and pumpkinseed sunfish, yellow perch, and American eels. However, the fish are of more interest to the naturalist than the sportsman. Because of the acidity of the water and the fact that all streams originate in the Barrens, the variety of fish is limited. Of particular interest is the group of small sunfish found in relatively common numbers in the Barrens but rare elsewhere. Noteworthy are the blackbanded sunfish, *Enneacanthus chaetodon;* banded sunfish, *Enneacanthus obesus;* and the bluespotted sunfish, *Enneacanthus gloriosus.*

Perhaps the most interesting and probably the most publicized animals of the Pine Barrens are the reptiles and amphibians. The herpetological fauna makes these sandy woodlands of great interest for herpetologists, professional and amateur; within the boundaries of the Pine Barrens can be found 52 species, which include 3 lizards, 17 snakes, 9 turtles, 2 toads, 11 frogs, and 10 salamanders.

The Barrens are rich in many species, including several forms that are rare or difficult to find in other areas. Numbered among these are the northern pine snake, the bog turtle, the carpenter frog, and the Pine Barrens tree frog. This last, *Hyla andersoni,* is one of the jewels of the amphibian world. Its ground color is a rich green, the underparts of the legs are a stunning orange-yellow in color, and a lavender stripe with white borders runs from the nostril, through the eye, and down the side of the body, strikingly separating the green dorsal color from the white belly.

A resident of cedar swamps and bogs, this species breeds in shallow pools, grassy and sphagnaceous in nature, from early May through June. The call of the male is likened to a nasal *quank* in sound, repeated 20 to 30 times at half-second intervals followed by approximately two minutes of silence. Outside of the Pine

Barrens, this small amphibian, reaching a length of little more than an inch, is known only from a few isolated populations in North Carolina and Georgia.

Another uncommon amphibian found in large numbers is the carpenter frog, *Rana virgatipes*, restricted to water with a high acidic content. This frog, whose common name comes from its call that resembles the banging of a hammer on a nail, is found in limited numbers through coastal areas; its range extends from New Jersey south to Georgia. It is known for its association with sphagnum bogs, its rich brown color blending perfectly with the brown water of these bogs. The frog averages two inches in length and has four yellowish stripes running down the length of its body breaking up the ground color, making the frog very difficult to see in its natural habitat.

Although considered uncommon throughout its range, it is abundant in the Pine Barrens, yet it lives in no other area in New Jersey. This is probably due to the acidic waters that have permitted the carpenter frog and the tree frog to localize and to flourish while reducing the competition from other species that are less tolerant to the acidic water.

Other frogs and toads from the Barrens include the eastern spadefoot, Fowler's toad, southern leopard frog, green frog, bullfrog, New Jersey chorus frog, northern cricket frog, wood frog, pickerel frog, gray tree frog, and spring peeper.

Of the three lizards found in the area, none are rare and only the ground skink, *Lygosoma laterale*, which has its northernmost range at this point, is restricted to the Pine Barrens. The other two forms are the northern fence lizard, *Sceloporus undulatus hyacinthus*, and the five-lined skink, *Eumeces fasciatus*.

The many lakes, streams, swamps, and cranberry bogs provide the habitat for the nine species of turtles found in the area. Of this group, the box turtle, *Terrapene carolina carolina*, is the only species that leads a more terrestrial than aquatic existence. Often found in the higher drier areas of the Barrens, it can be seen crossing the roads and highways in the early morning in its daily wanderings foraging for food.

The bog turtle, *Clemmys muhlenbergi*, is probably the rarest North American turtle. It has a spotty distribution, specimens having been reported from New York to North Carolina. Tiny even when adult, the bog turtle averages only about three-and-a-half inches in length. Still common in small colonies, this species has disappeared in many areas where it once lived. A resident of sphagnum bogs, clear slow-moving meadow streams, and swamps, it is usually dark brown or black in color, sometimes streaked with yellow. Its most striking characteristic is a large red or orange blotch on each side of the head. Occasionally it can be seen crossing over a mat of sphagnum moss or, during the hotter part of the day, tucked in among the tall tussocks of meadow grasses. The natural habitat of this turtle is quickly diminishing in the northern part of the state as extensive draining of bogs and meadows make room for housing projects and shopping centers. Probably in the next decade or two, this species will be limited in the state to the Pine Barrens alone.

Other species found in this area are the common snapping turtle, eastern painted turtle, red-bellied turtle, wood turtle *(Clemmys insculpta*, known only from the northern fringe area of the Barrens), spotted turtle, stinkpot turtle, and mud turtle.

The large amount of moist situations in low areas, bogs, swamps, and along stream banks has resulted in a good representation of salamanders in the Barrens.

The eastern mud salamander, *Pseudotriton montanus montanus*, is one of the rarest of the group, having only been discovered in 1953.

Other forms are the marbled salamander, eastern tiger salamander, red-backed salamander, four-toed salamander, northern two-lined salamander, northern red salamander, red-spotted newt, northern dusky salamander, and spotted salamander. The latter two forms are also considered rare.

The snakes of the Pine Barrens are the largest group of reptiles found in this region. Representatives of this group are found in all habitats of the area. The most common species found in the higher areas is the northern pine snake, *Pituophis melanoleucus melanoleucus*. This large snake averages four to five feet in length; however, larger specimens are not uncommon. It is colorful, with a ground color of white or light gray and large black blotches running down its back.

A powerful constrictor, this species feeds on mice, rats, birds, and an occasional squirrel or young rabbit. The pine snake has the ability to force air past an upright flap in its mouth, producing a loud threatening hiss when disturbed or threatened. The loudness of the snake's hiss can be attested to by anyone who has had the experience of surprising a pine snake in the open. Although very abundant in the Pine Barrens of southern New Jersey, it is scarce throughout the rest of its range.

Found in the higher areas of the Barrens is the northern pine snake, which averages four to five feet in length.

Found with the pine snake in the higher areas are the black racer, milk snake (*Lampropeltis doliata triangulum* X *temporalis*, an intergraded form), corn snake, scarlet snake, rough green snake, and pilot black snake. With the exception of the black racer and the rough green snake, these are burrowing snakes, ideally suited for the loose-packed sandy soil of the Pine Barrens region.

In the lower areas of a more moist situation, other snakes become more dominate. The timber rattlesnake, *Crotalus horridus horridus*, the only venomous snake in the region, frequents in particular the cedar bogs and fringe areas. Also present are the kingsnake, hognosed snake, northern water snake, eastern ribbon snake, and eastern garter snake, together with some of the smaller burrowing and secretive forms: northern red-bellied snake, northern brown snake, eastern worm snake, and the ringneck snake (*Diadophis punctatus punctatus* X *edwardsi*, another intergraded form).

Two snakes that have their northernmost distribution in the Pine Barrens have very interesting local histories and point out the ease with which species can be overlooked in this region. The corn snake, *Elaphe guttata guttata*, averages three to four feet in length, with a ground color that varies from reddish to tan and occasionally orange; toward the posterior area of the body and the tail, the ground color tends to become grayish in hue. Body blotches are large and deep red to brownish in color, bordered in black. The belly is white, strongly checked in black. A strong constrictor, this species is known for its eating of destructive rodents. Occasionally birds and bird eggs are eaten.

Although large and impressive in color, this snake eluded recognition in the state until 1912.

The second is the scarlet snake, *Cemophora coccinea copei.* It is a coral snake "mimic," easily identified by its pointed red snout; the body colors consist of broad red bands bordered with black, separated by narrow bands usually yellowish in color. The belly is white, occasionally yellow, and the dorsal bands do not invade the belly color. It is a burrowing form, averaging one-and-a-half feet in length. Specimens have been found under flat objects on the ground and in rotted logs, and occasionally have been dug up by farmers plowing their fields. Rarely in the open, it can be found after heavy rains or at night. The scarlet snake, a constrictor, feeds on small snakes, lizards, baby mice, and turtle eggs.

This species, known from less than 30 preserved specimens, is very rare in the state. It eluded discovery until its first description by Carl F. Kauffeld who reported two hibernating specimens dug up by some men digging sand at Whitesbog, Burlington County, during December 1934.

The reptiles are predators, chiefly feeding on insects, rodents, fish, and occasionally birds. Some forms feed on amphibians, smaller snakes, and lizards. Because fewer reptiles and amphibians frequent the higher ground areas, they have less impact in the predator role. It is in the lower moist areas where many species are concentrated that the reptiles perform a more significant role in the chain of life.

The Pine Barrens, with great size, structure, geographical position, wildlife, and a huge reserve of unpolluted water, are of great importance. As a biological refuge where conditions that were once widespread across North America still exist, the Pine Barrens afford unique possibilities for scientists to answer many of the questions concerning the past history of our continent.

OTTERS

RIVER OTTERS
SEA OTTERS
& PART-TIME OTTERS
PART II

BY JOSEPH A. DAVIS, JR.

While the "typical" otters carry on their lives pursuing a host of invertebrates and such fish as are not too difficult to catch, a second group of otters prowls the shorelines, probing in mud and under stones with sensitive fingers, seeking less active prey. These otters are the "clawless," or "small-clawed" otters, genus *Aonyx*, of India, Southeast Asia, and Africa, animals that have substituted an essentially raccoon-like feeding pattern for some of their old otter habits. In place of extensively webbed paws, these "part-time" otters have their forepaws modified into doll-like hands, organs which function as much like true hands as the hands of many monkeys.

There are two species of "part-time" otters: the large African species and a "toy" species, the small-clawed otter of Asia. The latter bears very much the outward relationship to its African cousin that a toy breed of dog does to the standard, except of course that it is a distinct species. As its name suggests, the small-clawed otter bears rudimentary, peg-like claws, growing upward from well behind the tip of each digit. Located as they are, these claws are not much subject to the wear a normal claw would get. It may be that the claws are worn down when the otter grubs under a stone, but my small-clawed otter, Butterworth, helps the process by nipping off the tips when they grow too long.

The African clawless otter begins life with tiny claws, but as the cub grows these are lost, except on the three middle toes of the hind feet. Evidently claws are not needed for most purposes by these otters, and their presence might actually be a hindrance, so they have been lost or reduced in size. The three persistent claws on the hind feet of the otherwise clawless African species have been retained because they serve the useful function of grooming tools. When an otter—even a "typical" one—scratches, its hind foot is flexed slightly and the first and fifth toes rarely, if ever, come into

OTTERS

use; the three middle toes, or their claws, do the grooming. Thus, in the compromise between the conflicting evolutionary pressures favoring the loss of claws for better tactile function and retention for grooming, only those claws which were actually used by the otter were kept.

All otters use their paws in play, even those with fully-webbed paws. My spot-necked otter, Samaki, can pick up a pea in his gross paw, when he wants to, but this pattern of behavior reaches its zenith in the clawless species, which spend more of their leisure time juggling small objects than other kinds of otters seem to. Butterworth will lie on his back with two or three marbles, bottle tops, or peas kept in endless motion by his paws. He will move them with the fingers, palm, or back of his small hand, rolling his toys up against his muzzle or passing them back along his abdomen, where his hind feet, only a little less dexterous, help to keep them moving. The two small-clawed otters in the Bronx Zoo do the same thing with pebbles from their enclosure, and such play must occur in the wild as well.

One habit that probably does not take place in the wild, but which is illustrative of the extreme manual orientation of the small-clawed otter, is its means of feeding in captivity. Given a balanced food mixture composed chiefly of ground meat, the "typical" otters take their food by the mouthful, like a dog or a cat. The small-clawed otter, on the other hand, almost invariably takes its food by the handful, transferring it then from paw to mouth.

The change in the form of the clawless otters' paws was correlated with their concentration on relatively inactive prey, for the most part hard-shelled crustaceans. Such creatures, however, cannot simply be eaten the way fish are, and the teeth of clawless otters have become modified to deal with hard shells. Those most typical of otters, the North American and Eurasian otters, possess an all-purpose dentition, with sharp edges for shearing and broad grinding surfaces to handle crayfish shells. Clawless otters have sacrificed some of the shearing characteristics of their teeth in favor of increasing their crushing surfaces.

The relative ease with which their prey can be captured has had another effect on the clawless otters. Just as the raccoons, with their similar habits of predation, have become stout-bodied in a family of slender species, so the clawless otters have lost much of the long sinuous form of their closest relatives. They swim well, and most likely do catch some fish, but the fish-chasing body shape, no longer so necessary, has given way to what must be a more practical form for its way of life.

Sometimes under conditions of captivity, clawless otters "wash" their food the way raccoons do, or just spend seemingly idle minutes sloshing their paws in their drinking water. The reason for "washing" in raccoons, a behavior pattern that seems never to have been reported in wild raccoons, is applicable to the otters as well. These animals, both raccoons and otters, normally capture a good percentage of their prey in shallow waters, after feeling around with their sensitive forepaws. M. Lyall-Watson, of the London Zoological Society, describing the feeling behavior of a raccoon, has aptly put it that "the raccoon gazes vacantly into the distance, as though the activity which is occupying the hands is far too menial to occupy the mind." Substitute the word "otter" for "raccoon" and the picture remains a perfect one.

The predatory act is not a single one, but at least four separate, sequential activities: searching, seizing, killing, and eating. Recent studies of cats by the German ethologist Paul Leyhausen indicate quantitatively that a cat becomes satiated with these acts in reverse order. Given an unlimited supply of live mice, a cat performs all four acts as

In captivity, the dexterous small-clawed otter (left) reaches for its food, which it will then transfer from paw to mouth by the handful, while a "typical" Sumatran otter (at right) takes its food by the mouthful.

it would in the wild. Eventually its hunger is satisfied, and it ceases to eat the mice it has killed. After a while the killing urge seems to be extinguished, and the cat merely stalks and captures its mice (the seemingly cruel act of toying with its prey, not cruelty at all, but obedience to an inborn command). Later the cat only stalks the mice, and still later ignores them completely. Rarely does a cat at large find so many mice that it would follow this pattern of step-by-step satiation, but the relative durability of the early stages of predatory activity appear to be a mechanism to keep a cat hunting even when it has missed the first few mice it tried to catch.

The same pattern can be found in otters. It explains the occasional "wanton" and wholesale killing an otter may perform in a fish hatchery, where prey is so numerous that hunger is quickly satisfied. It also explains why raccoons and clawless otters "wash" food and toys. Their first predatory act of searching takes place in shallow water. Fed consistently on land, as they are in captivity, the animals' searching and seizing drives are frustrated, but persist as part of the behavioral repertoire that must somehow be performed. Accordingly the animals take their "prey" (food or toy) to water, "lose" it by letting go of it, and then search for it again, and they do this even after their actual hunger has been satisfied. If the "prey" is ground meat, as it often is in captivity, the otter or raccoon may lose it permanently, as it disintegrates in the water, but he keeps searching, until the urge is satisfied.

A few decades ago even those zoologists who recognized the essential unity of otters as a group looked upon the sea otter, *Enhydra lutris*, as a creature somehow different, and some of them erected a separate subfamily for it. Today it is back in the otter subfamily, the *Lutrinae*, but it isn't difficult to see why the old taxonomists were led to separate it from the others.

The sea otter has a curious combination of stumpy forepaws that seem less than what they should be for an otter, and enormous flipper-like hind feet almost more suited for a seal than an otter. It has much the bulkiest body of all otters and by far the shortest tail for its size, so that, while it rarely surpasses five feet in total length, it may weigh as much as 75 lbs. By comparison, the Bronx Zoo's late giant otter, Suzie, just five feet long, weighed only 50 lbs. in her prime, at a time when she was just a shade heavier than she needed be. The giant otter's broad tail accounts for almost precisely one-third of its total length and is almost certainly of considerable use in steering and for propulsion under water. The sea otter's unimpressive tail is one-fifth or less of the animal's overall length. In all likelihood its use in maneuvering is minimal, partly because the enormous flipper-like hind feet must be more efficient in controlling direction than the smaller feet of other otters, and partly because a sea otter does not need to make split-second directional changes as it searches for its non-moving mollusc prey. Apparently these otters do catch some fish, but the bulk of their diet is made up of mussels, sea urchins, and other shellfish.

Why should the sea otter, an animal so aquatic that it even sleeps, at least part of the time, floating in the water, have such non-aquatic forepaws? The "typical" otters' forepaws are webbed, and while they are seldom used for

propulsion (except in leisurely dog-paddling), they are brought into play for steering in rapid swimming. The sea otter's forepaw is so small that it could have little effect for this purpose. Instead, it must be admirably suited to a different function.

Abalone hunters know that the only way to procure this large single-shelled mollusc is to catch it unawares, slip a knife under the shell, and flip it over quickly, before it can pull down tight on its rock. The sea otter's short, sturdy paws may be used for this purpose, to pry up abalones, as well as other sessile creatures. Certainly it does this with mussels, for I once watched one at Point Lobos, California, using its paws to hang tenaciously onto a mussel in shallow water. As incoming waves passed over this two-way battle for survival, the otter's body swayed in the onrushing water flow, but eventually it surfaced with the mussel in its paws. The manipulative ability of these paws, too, is not impaired by their form; with them a sea otter holds a mussel, turning it precisely for a better striking angle when it uses the anvil stone on its chest. Females have been seen to dandle their cubs in the air with them.

Recently, during a study session at the Woodland Park Zoo in Seattle, I was able to watch some sea otters closely, so closely in fact that on one occasion an otter evidently thought I was offering it the microphone I was holding, and reached out to take it from me. When he reached up with his forepaws I could see how flexible the fingers really are; they are capable of some flexing and a good amount of lateral separation, much more than the anatomical drawings of them ever suggested. The sea otters behaved in most ways far more like clawless otters than "typical" ones, and in their use of their hands, they looked for all the world like clawless otters wearing mittens. Along the same line, they seem to be wearing rubber "swim-fins" on their hind feet, and when they walk on land they do so with the same relative awkwardness and slapping sound of a skin diver similarly encumbered on the shore with apparel meant for an aqueous environment.

Two sea otters dine afloat on clams.

Now it might be well to backtrack and look at two species of "typical" otters so far mentioned only in passing; the foregoing discussion of the sea otter will help put them in perspective.

The first of these is the little marine otter, *Lutra felina*, known locally along the Chilean coast as "chinchimen," or "cat of the sea." One of the smallest of otters, reaching a maximum length of about three-and-a-half feet, the marine otter occupies the Pacific coast and coastal islands of South America, in the chilly waters of the Humboldt Current, from the southern tip of the continent northward to Peru, where the cold waters veer westward away from land. Over most of its range the marine otter shares the coast with mainland otters of another species, but it seems ecologically independent, for on at least one island, Chiloe, both otters are to be found.

The chinchimen's coat is harsher than those of other species of *Lutra*, but this did not protect it it from the natives of Tierra del Fuego, who sought its pelt to make warm capes in that inhospitable land. Some scientific expeditions have seen it and noted that it haunts the coastal waters, catching fish and crustaceans, which it brings to shore to eat. Apparently it also dens on land, and in these two particulars it behaves more like a *Lutra* otter rather than a true sea otter. But if the marine otter is a "typical" otter in form and general habits, it should possess the genetic basis for increasing its adaptation to this new way of life. It need not necessarily return to land to eat, for example. A North American otter I saw in the Dallas Zoo some years ago took a mass of its food mixture from its dish, plunged into the pool, and swam away on its back with the food on its chest. Using its forepaws the otter then conveyed bits of food to its mouth, sea otter fashion. The marine otter, its close relative, must also have this ability in its behavioral repertoire; should the need to dine at sea arise, it ought to be able to forego taking its prey to land.

One of the major differences between the real sea otter and the marine otter is that the dentition of the latter has not become specialized for a diet of hard-shelled creatures and remains generalized,

as it is in other *Lutra.* That, along with its relatively unmodified *Lutra* body form, suggests that it is more of a fish eater and probably must handle larger creatures than the normally morsel-sized invertebrates the sea otter eats. Maybe the larger size of its prey makes eating on land more practical. Unfortunately, the men who saw the otters eating fish did not comment on the size of the fish.

The small-clawed otter in this photograph is holding with its right paw a large pebble that it has picked up from its enclosure at the Bronx Zoo.

Finally, there is *Lutrogale perspicillata,* the smooth otter. It is apparently an old species whose range is shrinking, for a small population lives today in the marshes of Iraq, some 1200 miles from the westernmost edge of the major part of its range in India, Southeast Asia, and the Indonesian islands. Many taxonomists include the smooth otter in the genus *Lutra,* on the basis of a few superficial resemblances. The smooth otter is a "typical" otter, slender and sinuous, with fully webbed feet, well-developed claws, and as far as is known, a mixed diet composed principally of fish. But when the smooth otter vocalizes, its calls resemble none of the "dialects" of *Lutra* otters, being more nearly like the cries of the clawless species.

In other aspects of its behavior it seems to share more in common with the clawless otters and sea otter than with *Lutra.* As of the moment "seems" is the important word, because there are not enough observations on which to base a firm conclusion. I know of two smooth otters, for example, that have been seen to tuck objects under their forearms for safe keeping while swimming—something only the sea otter is known to do. On one occasion author Gavin Maxwell found his smooth otter, Mijbil, "floating on his back, apparently fast asleep, with a bunch of scarlet rowan berries clasped to his chest with one arm," another bit of behavior reminiscent of the sea otter, and not, to my knowledge, found in *Lutra* otters.

What can be said about the otters as a group? They are all aquatic to some degree, and all of them nourish themselves on water-dwelling creatures. All are sociable, without any known formal social hierarchy, forming loose associations of a temporary nature at least. All are so efficient in the matter of procuring food that they have a great deal of time for the luxury of play. All are adaptable, within the limitations of a water-bound existence, to the extent that (in most cases) they eat whatever is most abundant and easy to catch and (except for the sea otter, perhaps) are not limited by the population levels of one or a few prey species. All have learned about the new enemy, man, who appeared after their species arose. When Vitus Bering discovered the sea otter in 1741, he found he could club to death 800 of them and cease the slaughter only because his boat would hold no more; this animal now warily avoids human intruders into its domain. In most parts of the world otters, diurnal by preference, have become silent shadows under starlight to avoid man, yet it is not unusual for an otter caught as an adult to become nearly as tame and trusting as a dog if treated well.

Otters seem to be able to cope with anything new, and because of this they spread, before man did, throughout the waterways of most of the world. They have managed to cope with geological change and, until recently, with human predation. But it seems unlikely that they can meet one expanding threat, the industrial poisoning of the waters from which their living derives.

It might be fitting to close with a comment on what the future holds for the otters. Will the sea otter grow more seal-like in form as its environment shapes it more and more to the requirements of ocean life? Will the marine otter in time come to resemble today's sea otter? Is the clawless otter destined to become a purely terrestrial carnivore? These are questions of the kind asked frequently by the zoologists of the first third of this century, who looked at the evolutionary history of a species and attempted to extrapolate the future in the same light. Such speculations seem no longer to concern today's taxonomists; the question, as we move into the last third of the twentieth century, is not how the species will evolve in the next millenia, but how they will survive the near future. With every year there are fewer otters. And more and more men.

CLOSE-UP ON THE BIRDS OF PREY/PHOTOGRAPHS BY WILLIAM MENG

The art of training birds of prey to pursue small game is rooted deep in man's past. Falconry is practiced on a world-wide scale and is part of the traditions of many cultures, both Western and Oriental. Its exact origins probably will never be clarified but many students of falconry believe that it was initiated by the horse nomands of High Asia, thousands of years ago.

The lure of falconry is tied to human fascination for hawks and eagles, which are among the world's most magnificent birds. The imagination is easily captured by the sight of a peregrine falcon, for instance, climbing high into the sky and then dropping toward its quarry at almost two hundred

Ernst C. F. Jocher, of Falconry of Ireland, Ltd., addresses a tawny eagle, above, one of the birds of prey he brought to the Bronx Zoo for demonstrations of the hunting birds in flight. At upper left, a caracara returns to its perch. Overleaf is the red kite, shown in color on the front cover.

miles an hour. Certainly the American bald eagle impressed this nation's founders so that they made it the national symbol.

Today, however, the peregrine and even the bald eagle are disappearing from the skies. So are many other species of the birds of prey, including the great California condor, the Everglades kite, and the monkey-eating eagle of the Philippines.

If birds such as these are to survive, they must not be hunted and their habitats must be preserved. Public awareness of their plight and of their place in nature is essential. It was in this spirit that falconer Ernst C. F. Jocher, one of Europe's best-known practioners of the art, was brought to the Bronx Zoo in October to stage special demonstrations of the hunting birds in flight.

Mr. Jocher, of the Falconry of Ireland, Ltd. (Clonmel, County Tipperary, Ireland), brought with him a dozen birds of several species, including a huge black (hooded) vulture, two tawny eagles, a golden eagle, and a red kite.

The purpose of the demonstrations, which ran for more than two weeks, was to develop public interest in the birds of prey and in a more intimate concern for their future. Thousands of zoo-goers witnessed the daily exhibitions, during which many of the birds were loosed in free flight.

Helga Geissel, Mr. Jocher's daughter and assistant, seen at upper right, prepares to toss aloft a European buzzard. At center, a tawny eagle spreads its wings. The black (hooded) vulture, at bottom, is the largest of the birds of prey Mr. Jocher brought with him from his home in Ireland.

ANT ARMIES OF TROPICAL AMERICA BY ANTONY GAHAN

Imagine a horde of army ants, half-a-million strong, sweeping across a tropical American jungle floor on a front 50-feet wide. Grasshoppers, beetles, cockroaches, spiders, scorpions are all mastered and dismembered to be taken in pieces back to the colony camp or to food piles along the line of march.

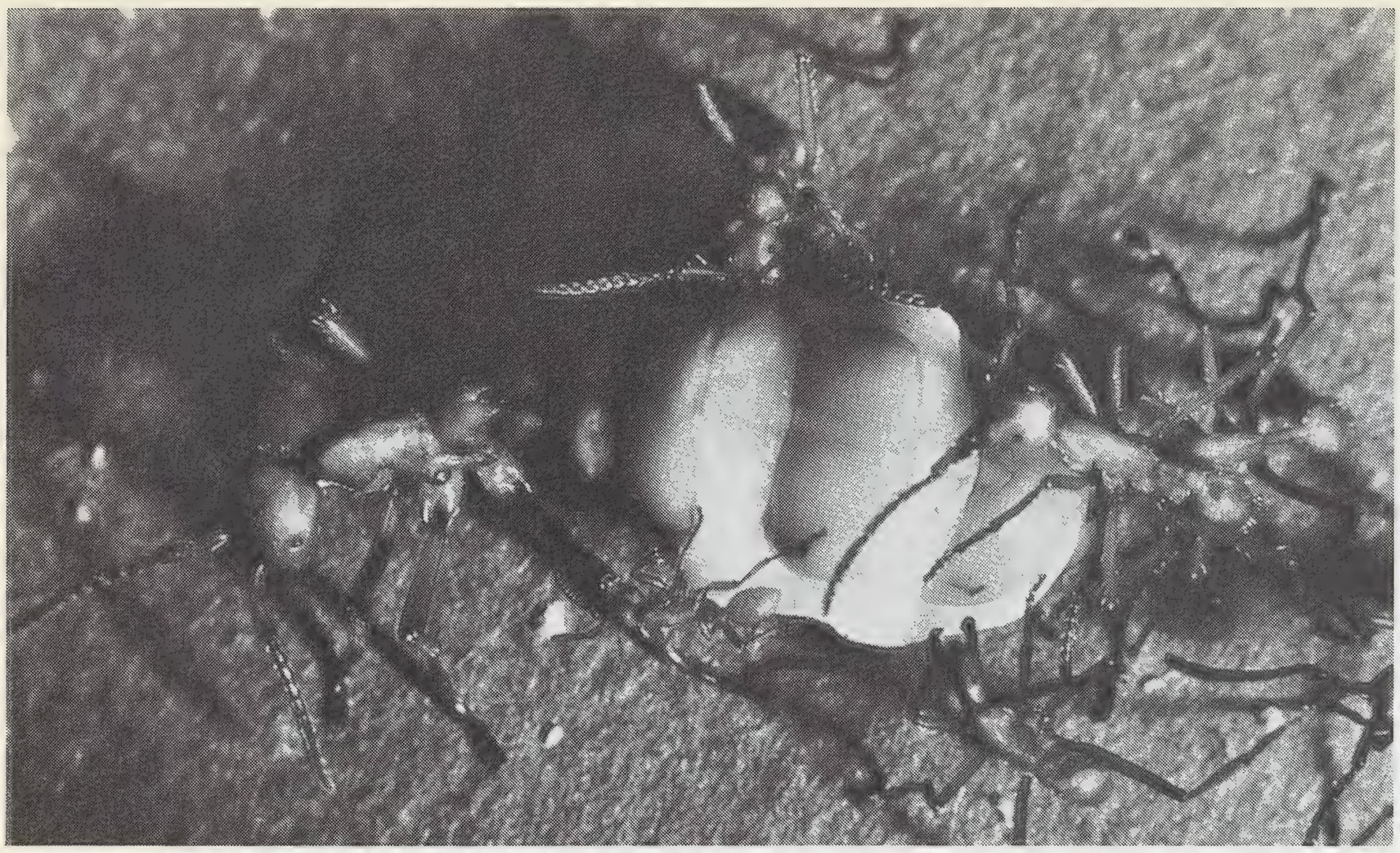
Flying insects, who flee to the air, may fare little better among the swarm of ant birds that circle over the advancing army. Only a few creatures, such as the immobile stick insects and some especially pungent ticks, are spared. Snakes and lizards too can fall victim to the biting wave.

Larger animals can usually get out of the way in time, unless they are asleep or injured. Most army ants gain little from attacking such creatures, however, since they cannot cut through mammalian or bird skin. Nesting birds have been found bitten to death by these ants, but they were left intact. Only the driver ants of the Old World, with their cutting, shearing mandibles and even more tremendous numbers, have truly earned the reputation of killing and tearing to bits large and small forest animals and livestock unable to escape them.

The toll that tropical American ant armies take is truly remarkable none the less and probably makes a substantial contribution to keeping jungle insect life in check. It is said that people living in these regions often regard an army ant invasion as a blessing. When ant swarms approach their thatch homes, the inhabitants take their food, pets, and children and move out for a few hours while the ants go through walls and ceiling, cleaning out the accumulated vermin living there. When the "living pesticide" has passed on, the people move back into their now completely pest-free homes.

The thoroughness of an army ant sweep is also shown by the story of the entomologist who was surveying the typical fauna of the jungle floor. Laying down his collecting frame over an area, he was startled at the amazing paucity of life in it. He could find no explanation until he spoke to a colleague who was studying army ant movements and found that a colony of these ants had passed through his collecting site a few days before.

Tropical American army ants belong to the Doryline ant subfamily, whose species abound in tropical and semi-tropical regions of Asia and Africa, as well as the New World. Dorylines range in individual and colony size from the large African driver ants, with up to 20 million individ-



An *Eciton* queen, her bloated abdomen still stuffed with ripe eggs, is attended by worker ants as she rests between egg-laying bouts (upper left).

The eggs — 200 to 400 at a time — are laid by the queen in a broad ribbon (upper right).

The only winged army ants are the males, which also possess well-developed eyes (left). Males are also the only army ants to stray naturally from the colony group.

uals in a single colony, down to the tiny and relatively primitive *Aenictus* of East Asia, with less than a hundred thousand individuals per colony. Over the 55 million years of ant evolution, the Dorylines have radiated into all sorts of habitats. Some species live mainly on the surface of the ground, even ranging up into trees and bushes; others spend their lives mostly underground, emerging at times on the surface. Still others live deep underground, and seldom, if ever, surface.

All are nomadic predatory raiders, with single wingless queens and winged wasp-like males.

The great mass of colony members are sterile female workers, offspring of a single mother, the queen. The only fertile female in the colony, she lays a new brood at intervals, about one every 33 to 36 days in the best-studied *Eciton* species of Central America. The usual brood has been found to number close to one-quarter of the colony total, or between 25,000 and 2 million depending on the species. Since the average queen is thought to live three to five years, this means that an *Eciton burchelli* queen, for example, may lay about 15 million eggs in her lifetime.

This also means that the average worker ant lives only four months or so. In part this results from the great toll taken by opposing insects, especially other ants. In part they may literally die from overwork. The late Dr. Theodore C. Schneirla, a curator of animal behavior at the American Museum of Natural History, New York City, and a leading expert on army ant life and behavior, found that there is nothing biologically necessary about this. He reported that in each colony there are a group of workers who live permanently in close attendance upon the queen. Sharing her protected environment at the center of the colony nest, they survive far longer than the typical worker, probably for years.

While keeping the colony going with great broods of new ants, the queen also unifies it with her own distinctive smell. This odor, from the secretions of special glands, is different not only from those of other ant species but also from all other queens of her own species. Through this odor her ants "know" each other. The odor attaches to newly laid eggs and the larvae hatching from them, causing the workers to care for these larvae while killing larvae captured in raids. To fully appreciate this, we must realize that most army ant workers have poor eyesight, if they are not completely blind. For them smell and touch are the key senses. Grooming and licking, which mammals find pleasant, actually seem to be vital

to successful ant growth and development.

While the queen is alive her workers never mix with other army ants. When two columns meet in the jungle, the leading edges stop and line up facing each other. For a while the ants stand there, antennae quivering, until one group or the other turns and goes in the other direction. Deprived of their queen by natural accident, disease, or the hand of a scientific researcher, worker ants soon lose her distinctive odor. Now they will join readily with another colony of their species, and the other colony will accept them. Interestingly enough, the acceptance does not extend to the larval brood of the queenless colony, which is soon eaten up.

In most army ant species different members of any colony vary greatly in size or have different organs more or less developed. This variation occurs not only between the sexes, or between the fertile queen and her sterile female offspring, but also among the workers themselves.

Males, for example, are the only winged army ants, the only ones that stray from the colony group. Also, all males have well-developed eyes, even those of species where the workers are completely blind. For many years male army ants, caught when they were attracted to shining lights, were thought to be varieties of wasps and not ants at all. It was only after army ants had been recognized and thoroughly classified that entomologists realized these flying creatures were army ant males.

Army ant queens are the largest members of their colonies. In addition to their great egg producing equipment, they also have the expanded respiratory and digestive tracts needed to keep going while nurturing and laying their tremendous masses of eggs. The queens are also unique in undergoing great physical changes, from the enormously swollen gravid condition to the non-laying but still large queen, with compact abdomen, which runs in colony emigration.

Such sexual variation is common in many creatures, especially insects. Rarer, however, are the differences within the worker population. *Eciton* workers, for example, range from majors a half-inch long down to minims only one-eighth-inch in length. The majors alone possess great oversized heads and enormous long hooked mandibles.

Each size has a special place in colony life. The clumsy majors, with their giant jaws, are usually pushed aside by the smaller faster ants and often line up along the sides of the ant trails. Here they serve admirably to attack and drive off any intruders. Only the youngest and most inexperienced anteater will attack an army ant column or bivouac. He will likely do it just once and will remember the painful lesson thereafter. Indeed, so firmly do the majors fasten their teeth into an attacker that people have been known to close a wound by holding the edges together, letting a series of these ants grip both sides of the wound at intervals, and then cutting off the ants' bodies, leaving the heads as rude sutures. The ant head muscles will hold the wound shut until it heals; then the heads can be crushed and the mandibles removed like any other sutures.

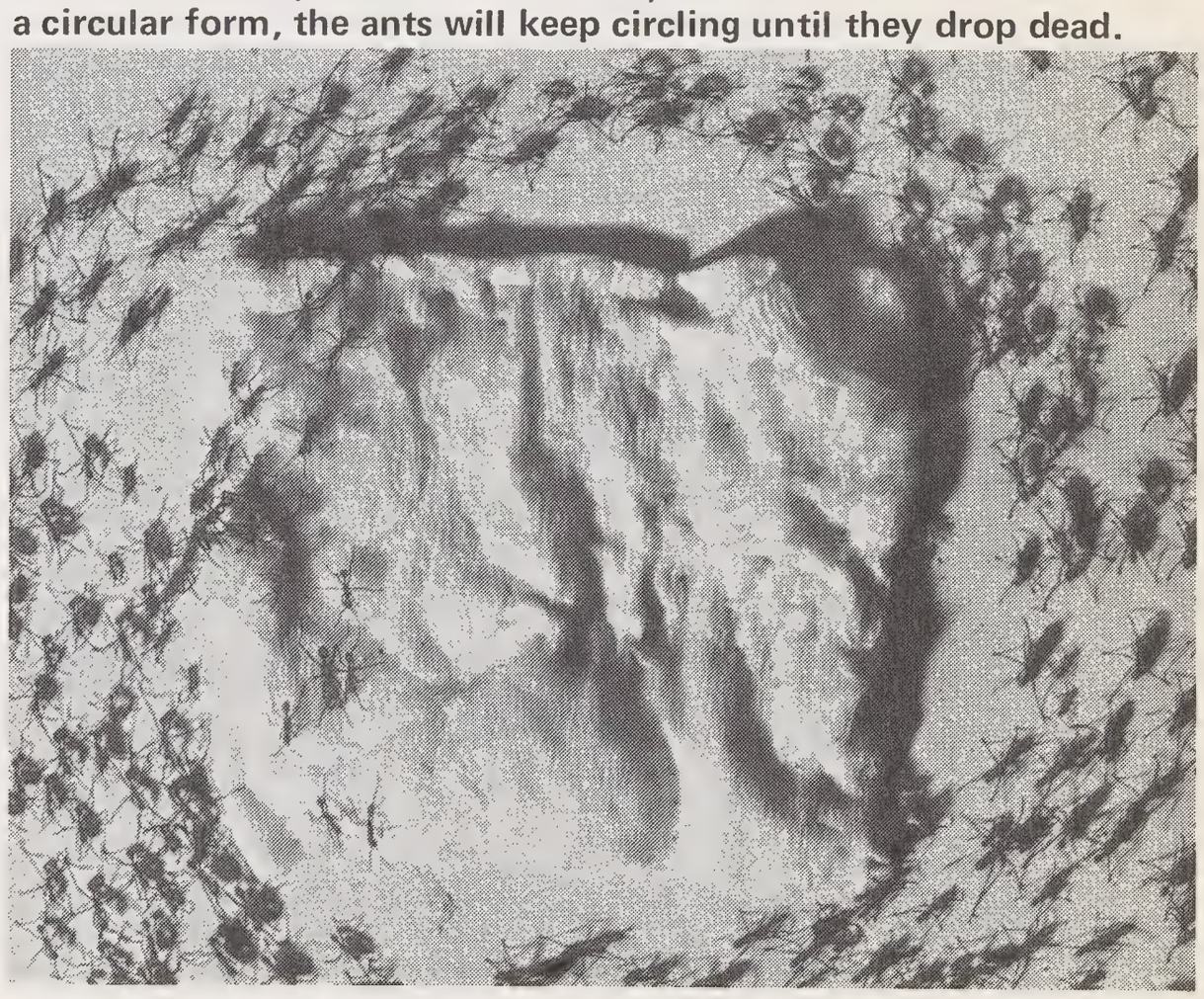
The minims, too small to attack most foes or carry most pieces of food, are just the right size to penetrate the nests of other insects to carry off their eggs and larvae. Where there are pits or cracks in the trail, these minims are often pushed down inside to pile up and create a more even roadbed.

The various intermediate-sized workers do most of the basic work of the colony: killing prey, carrying booty, feeding and transporting their own larvae.

It was long thought that army ants would stay in one area until they had raided out the local food supply and then move on. We now know that all important colony movements are part of a complex cycle determined by the activity level of the worker ants. We also know that this activity level in turn is controlled by the developmental stage of each growing brood.

Seen from the outside, an *Eciton* colony, for example, will spend 10 to 16 days on the move. Massive daily raids from temporary camps alternate with nightly emigrations to new camps. Then this stops abruptly, and the colony spends some

Army ants follow trails marked by secretions from colony mates; if some incident, natural or artificial, causes this trail to take a circular form, the ants will keep circling until they drop dead.



18 to 23 days in one place, mounting light raids from time to time.

Closer examination reveals how brood stages control colony life, including even the physiology and behavior of the queen which hatched these broods in the first place.

As newly laid eggs become in turn hungry larvae, passive pupae, and vigorous young workers, they interact with the adult worker population to spur or dampen this activity. The end of each brood sequence overlaps with the beginning of the next, producing a smooth alternation of vigorous activity with relative inaction.

The active, or *nomadic phase*, starts when young adult workers emerge from their cocoons to energize the colony and set off the first massive raid and emigration. The queen, recovered from her great egg-laying chores of the last quiet period, remains in the bivouac by day, then runs in the emigrations at night. The quiet, or *statary phase*, starts when the now inactive larvae spin cocoons and become immobile. No longer excited by contact with the wriggling, food-gobbling larvae, the workers calm down. The raids that sometimes issue forth from the colony camp are shorter than before, use fewer ants, and fall far short of stimulating a general emigration.

The main work of this period is done by the queen. As the previous nomadic phase draws to a close, the mass cocoon-spinning of the full-grown larvae sets off a last big raid. Since the now pupating brood cannot eat any of the food gathered in this raid, the workers begin to ply the queen with it instead. As she gorges herself, she secretes more and more of her vital scent attracting more and more food-bearing workers to her.

All this eating combines with the contact stimulation of the excited ants around her to speed up the maturation of her next supply of eggs. After some six days of this life she is ready, her bloated abdomen stuffed with ripe eggs. They come out in a broad ribbon, 200 to 400 at a time. Between these batches of eggs, the queen discharges a milky fluid which the highly excited workers around her lick up avidly. They also lick the eggs, giving them a thin adhesive coating that aids the handling of them in packets and may also protect the eggs.

When egg laying ends, both queen and colony reach their lowest ebb. Community survival, however, demands that the queen revive rapidly, since the next nomadic phase is not far off. It is fascinating that the first tremor of that phase is what seems to do the job. The nearly-mature pupae start to stir inside their cocoons. This is just enough to stimulate some food-gathering raids without setting off the emigration for which the queen is not yet ready. Nourished by this infusion of fresh food, and the worker attention accompanying it, she soon regains her strength.

The typical army ant brood consists of large numbers of fertilized eggs. Because of the great number of larvae sharing the colony's food resources, they are all underfed. As a result, the full growth potential available in their genetic makeup is not realized. Thus, they mature into sterile females, with many body organs small and atrophied.

About once each year, however, a colony produces what is called a sexual brood. This can happen when the queen starts to lay her eggs during a dry spell. As the dry air strikes her in the "delicate" condition of egg-laying, it may interfere with the normal fertilization process and kill most of the eggs. As a result the colony is left with a few fertilized eggs—those first laid—and a moderate number of living but unfertilized eggs.

Evidence from other insects suggests that females develop from fertilized eggs while males develop from unfertilized eggs. An army ant sexual brood, therefore, consists of a few young females (perhaps 20 at most) and up to 1,500 males.

It is upon this tiny number of larvae, less than one percent of the usual number, that the workers lavish their attention and food supply. First the larvae feed from the mass of eggs that have not yet hatched. Starting with this ultra-rich diet, they grow rapidly, attaining a size and complexity far beyond that of even the biggest worker larvae. When the excess eggs are used up, the sexual brood is fed from the great stores gathered on each day's raids. It is quite possible that this numerically small group of larvae may eat even more than that eaten by the enormous masses of larvae in a typical worker brood.

As they grow in this abundant environment, the larvae respond to the attention usually lavished on a far larger brood with secretions which give off odors that made them even more attractive to the workers. This heightened attention in turn further stimulates the larvae, while their enormous food supply enables them to develop the strong movements and secretions that attract the workers.

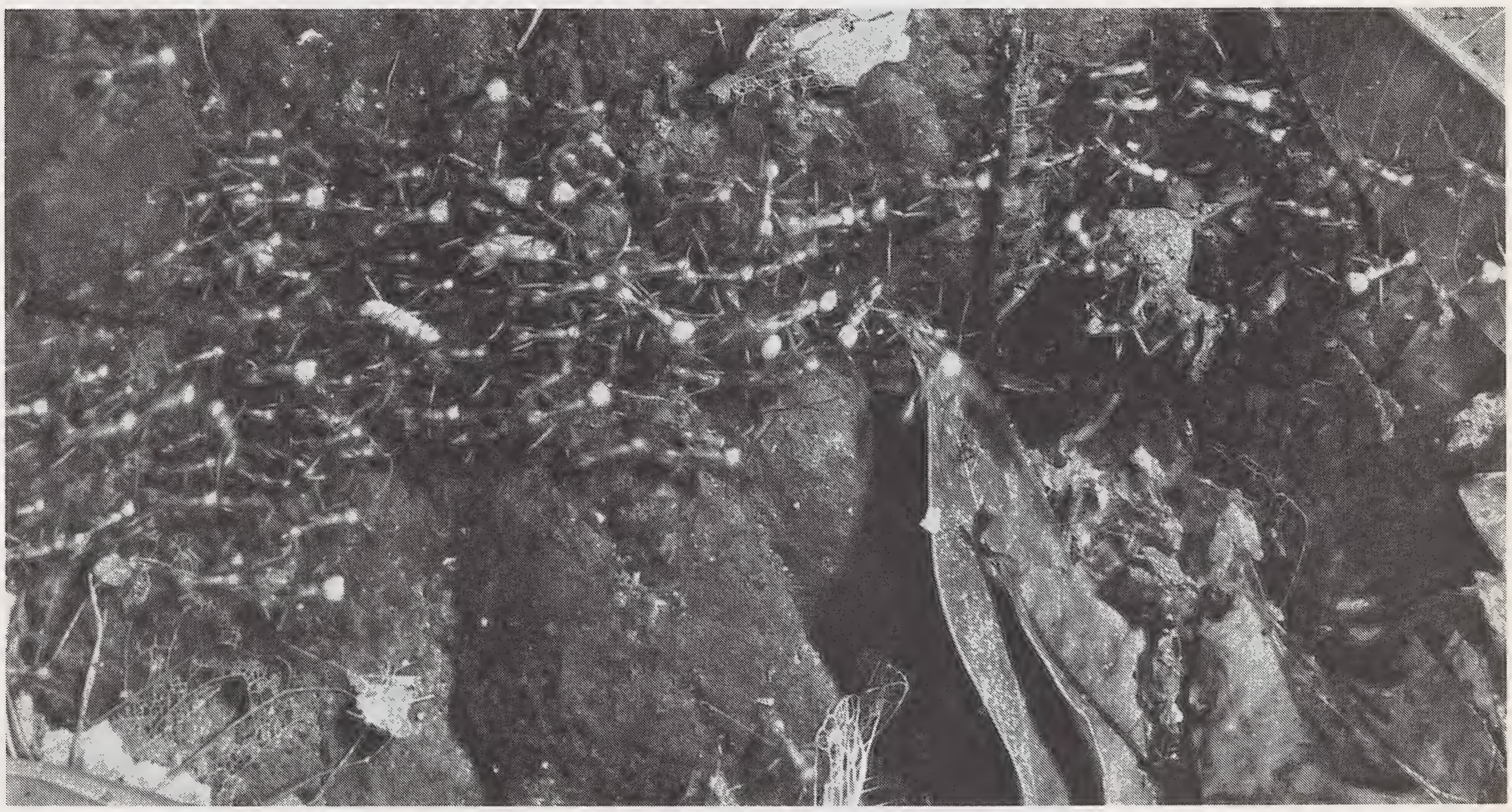
A brood of worker larvae is, of course, attractive to the adult ants in the colony. It must be, in order to get any attention at all. But this rather mild relationship between adult worker and worker larva never approaches the far stronger bond between worker and queen. The mutual stimulation between sexual brood and worker,

however, based on secretions similar to those of the queen herself, soon divides the inside of the bivouac more and more into the queen's section and the brood's section, and the workers more and more into queen-associated and brood-associated groups.

Experimental tests have been used to show the degree of this division. Under normal colony conditions, if a queen is taken away from her colony and then put down near colony workers, they flock to her at once. In a colony with a sexual brood, however, only some of the workers come to the queen, while others will ignore her.

Among the many examples of new colony formation that Dr. Schneirla recorded, there was only one in which two of the young queens had equal drawing power and the colony split three ways. There was also one case in which the old queen could not hold enough workers to continue her queenship. Instead she was discarded and the colony divided between two young queens.

Against this highly efficient system of army ant colony multiplication stand the jungle hazards that destroy ant colonies and hold the number in any one area pretty steady. As in so many aspects of colony life, here too the queen is the key. If a



An *Eciton* raid sweeps across the jungle floor causing the death or the flight of almost all animal life that it encounters along its line of march.

Throughout sexual brood development, this progressive colony division is strictly internal, and the community continues to raid and migrate as a unit. When the adult queens emerge from their cocoons, however, the colony begins to divide. One-half sticks with the old queen, goes off with her, and so in a sense continues the original colony. The other half focuses on one of the newly-emerged queens, goes off with her, and starts a daughter colony.

The males come out of their cocoons to live and migrate with one or the other section for a while, and then fly off. Eventually a few survive to land again, shed their wings, become attached to other colonies, and mate with their queens.

The extra young queens, while attracting smaller groups of workers at first, soon lose them to the major movements of the colony population. Eventually they are completely deserted and die.

sudden flood drowns a few hundred thousand workers, the colony may survive. If it destroys the queen, they are doomed. Also, as queens tend to grow older, they may weaken and fall prey to the many parasites that even a healthy queen and colony carry about with them.

Bereft of their queen, without the unity her special scent provides, a colony falls apart. Its raiding becomes aimless and aborted, and its tight well-ordered bivouac breaks down into a spreadout mass. The colony can no longer defend itself or its brood and is soon wiped out.

During one of his many ant studying expeditions, Dr. Schneirla came upon an *Eciton* colony in the last stages of disruption. In one place only was there a concentrated clump of worker ants. Probing into it he found them clustered pathetically around the last trace of their colony scent, the headless, dried corpse of their dead queen.

"SO REMORSELESS A HAVOC"

CAN THE GREAT WHALES SURVIVE?

Lesser Rorqual whale displays the parallel, deep grooves on the throat surface, characteristic of this whale family.

by Edward Edelson

Of all the living creatures that have existed on earth, none are more awesome than the great whales. But ours may be the last generation to study the unique habits and capabilities of some of the most interesting of these aquatic mammals. Relentlessly, the great whales are being hunted to—and perhaps already over—the brink of extinction. And while it may not be too late to save some species, the whale hunters show few signs of heeding the warnings of the ultimate results of their greed.

The danger is limited to about a dozen of the more than one hundred species of whales, but these include the most impressive of the order Cetacea. Among the threatened species are the blue whale, the largest animal known to have lived on earth; the humpback whale, rich in oil and therefore commercially valuable; and the sperm whale, the central symbol around which Herman Melville wrote *Moby Dick*.

All whales are divided into two suborders, the Odontoceti, or toothed whales, and the Mysticeti, the baleen or whalebone whales. They are true mammals, suckling their young, breathing air, and having warm blood. But the adaptations whales have made to marine life place them in a category by themselves.

The adaptations start with the whales' skeletons. The only sign of the hind limbs their ancestors once had are some small bones that are the remains of the pelvis and leg bones. The front limbs have been modified into flippers, which are used for steering and balancing. The cervical vertebrae have become shortened and in some cases have even fused, and there is no sign of a neck. Perhaps the most unusual modification is the skull. The nostrils have moved to the top of the head to form the "blowhole" through which the whales breathes when it surfaces—for, although the whale is beautifully suited to a marine life, it must breathe air like any other mammal. It is a matter of a few seconds for a whale to breathe out, and the exhalation results in the spout, or "blow," which enables whalers to sight their prey.

In a single inhalation, a 70-foot finback whale, for instance, can take in up to 500 gallons of air. Its ability to stand long dives at great pressures is due to several adaptations which are not fully understood—the muscle tissues can store large quantities of oxygen, the nitrogen that causes the "bends" in human divers is somehow absorbed, and the air supply is directed to essential organs, such as the brain, during dives.

Toothed whales—the suborder includes porpoises and dolphins—can have anywhere from none to dozens of teeth. Baleen whales, however, have one of the most unusual feeding apparatuses known. Baleen consists of long triangular sheets of "whalebone"—actually keratin, the same material our fingernails are made of—that grow from the roof of the whale's mouth. In the right whale a single sheet of baleen, a quarter of an inch thick, can be 10 feet long and a foot across at its widest point. A right whale has 300 to 400 sheets of baleen on each side of its mouth. While the front edges are smooth, the trailing edges fray out in fringes that interweave to form a strainer.

A baleen whale feeds by swimming through shoals of small marine animals—often the food is krill, small shrimp-like crutaceans—with its mouth open. Myriad tiny animals pour in with the vast amounts of water. Periodically the whale closes its mouth and brings up its tongue, sweeping out the water. The food remains on the baleen fringes, to be licked backward and swallowed.

The whale's most obvious adaptation is its torpedo-like shape, which allows it to achieve great speeds—finbacks, for example, make more than 20 knots, in some cases, although the usual cruising speed of a whale is much slower. A whale is driven forward by its flukes, the horizontal fins that form the tail. The muscles that drive the flukes take up most of the hind-third of the whale's body, and they can generate great power. A blue whale reportedly once dragged a 90-foot ship forward for more than eight hours, even though the vessel's engines were driving at full speed in the opposite direction, and a 30-foot killer whale can break through a four-foot ice floe.

Oddly enough, the skin of many species is not much thicker than celophane. The lower layers of the skin merge with the thick layer of fat called

blubber that gives a whale its streamlined shape. Blubber keeps the whale insulated from the cold water in which it swims. It also serves as a food storage system, similar to human fat. And it provides a major explanation for the long relationship between man and whale, since it yields most of the whale oil that still remains a valuable commercial product.

The scientific study of whales is relatively new and still incomplete. New species are even now being discovered, and there are information gaps on some basic points. But in a more elementary way, as hunter to prey, men have known whales for long centuries.

The right whale, for instance, had earned its name by the 17th century, because it was the "right" whale to hunt. It could not swim fast enough to escape the oar-propelled boats of the era, and it floated after it was killed. Right whales are in the baleen suborder, and cetologists still differ about the number of species that are in the family. Some divide the black right whales into two species, those that live in the northern seas and those that live in the southern oceans, while others say that there is only one species.

The two populations apparently do not meet at all. Each migrates to the Equator during the winter months in its hemisphere, returning to the poles to breed and to spend the summer. As the centuries-old hunting for its blubber became more intense, the animal became more difficult to find, and the black right whale began to vanish from the seas by the end of the 17th century. Today, a sighting is rare—even though whalers, somewhat belatedly, now protect the black right whale.

The same is true of the slightly larger bowhead, or Greenland right whale, which can be over 50 feet long. During the 18th century, a whaling expedition could cover its expenses with the baleen and oil from a single bowhead, but the greatest pressure to hunt the animal came with the popularity of whalebone stays. The bowhead has more than 300 sheets of baleen on each side, up to 15 feet long, and a single large animal yields a ton of whalebone, worth $3,500 on the market of that time. Inevitably, bowheads were overhunted. Today, there is a real question as to the number of bowheads surviving, and the ultimate fate of the species.

A slightly happier tale can be told of the gray whale, another baleen whale that was hunted during the age of sail. The grays, which grow to 45 feet in length, spend their summers in the Bering Sea and near the shores of the Arctic Ocean. In the fall, half go down the Pacific coast of America, the rest down the east coast of Asia. Their calves are born in late January, and they start back north shortly afterward.

While the gray whales do not yield as much baleen as the black rights, oil provided sufficient excuse for their slaughter. Historically, Eskimos and Indians killed some during the whale migrations, but hunting by whaling interests began in earnest by 1846. By 1890, the grays had vanished from the American coast, and they were thought to be extinct. Later, however, they began to return, and their numbers have grown through the years. They still are protected, and an estimated 3,000 gray whales now make the annual migration from the Arctic to lower California.

The sperm whale, or Cachalot, managed to escape near-extinction in the 19th century, but it is now in danger. This whale was hunted not only for the oil from its blubber but also for its spermaceti, from which came the oil that made the best candles of the 19th century. The sperm whale can grow to 60 feet, and a third of that length consists of its head. In the head is a huge rectangular reservoir containing the spermaceti, which is still used commercially for fine lubricating oil and to make cosmetics.

The sperm whale is a beast on which to build legends. Albino sperm whales have been sighted, and Moby Dick could have been an albino rogue male, driven off from a herd after a fight for supremacy. Sperm whales often doze near the surface, where they have been rammed by ships. And their diving abilities lend themselves to exaggerated descriptions. They can remain submerged for more than an hour and are believed to dive to more than 600 fathoms.

Sperm whales usually are found in the tropics, following the squid that are their major food source. For some reason, the males follow one route and the females and young another. Twice a year they meet, to split into groups, or "gams," of all ages and sexes.

Even when whalers were using the primitive methods of the 19th century, Melville was moved to ask whether "Leviathan can long endure so wide a chase, and so remorseless a havoc; whether he must not at last be exterminated from the waters." Not long after Melville wrote those words, a Norwegian named Svend Foyn in 1864 invented the basic tool of the modern whaling industry: the harpoon gun. Firing a projectile with an explosive head, the gun kills the whale quickly. The whale is then brought alongside and inflated with air to keep it from sinking.

It took 15 years for Foyn's gun to be adopted,

but since then the modern whaling fleet—with catcher boats firing harpoon guns and factory ships efficiently harvesting the catch—has come to a fine peak of effectiveness. The result has been overhunting of a kind never before possible.

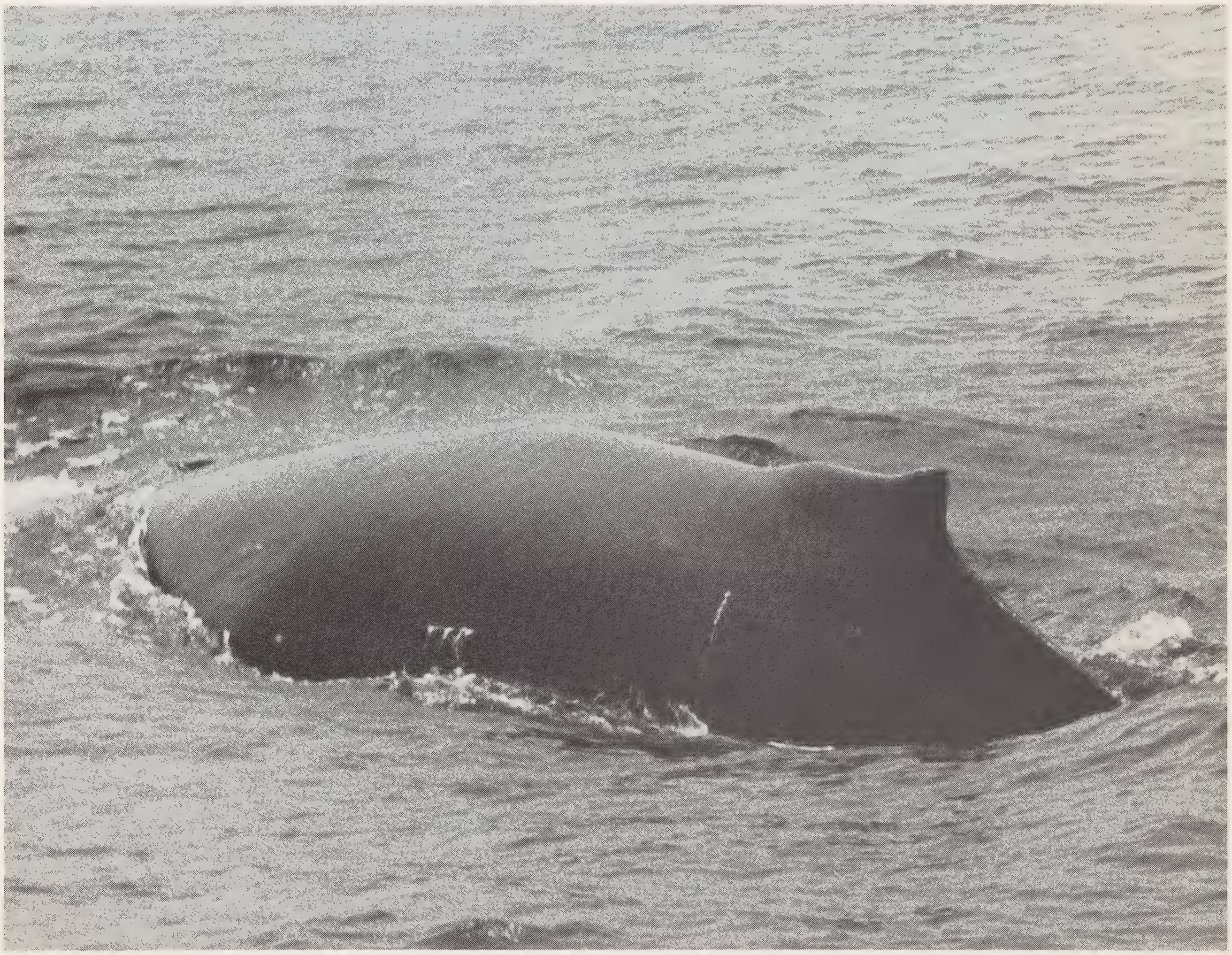
Foyn's technology enabled men to hunt the largest whale of all—the blue. A baby blue whale, born after a gestation period believed to last about a year, can be 23 feet long, and it will double that length in eight months. A typical blue whale, up to 100 feet long and weighing more than 130 tons, will yield 20 tons of oil. The blue was so much the ideal quarry of whalers that quotas now are set in "blue-whale units."

The blue whale is a member of the family Balaenopteridae, or Rorquals, as are all other whales that are hunted in large numbers (except for the sperm whale). The Rorquals include Bryde's whale, the sei whale and the two Minke whales, which count as one-sixth of a blue-whale unit each; the finback whale, which counts one-half a blue-whale unit; and the humpback whale, which counts as two-fifths of a blue-whale unit. The ratings are on the basis of the amount of oil obtained from each whale.

The Rorquals share one unusual feature: a series of parallel, deep grooves on the surface of the throat and upper chest. These deep pleated grooves can be puffed out to perform whatever function they do perform, but cetologists are limited to speculation on the subject. They variously theorize that the grooves serve as stabilizers during swimming, that they may help empty the whale's mouth of water during feeding, that they may serve some purpose in respiration, or even that they may serve as a brake for sudden stops.

This lack of definite knowledge is not unusual in cetology. Both the blue whale and the finback at one time were called *Balaenoptera musculus* (the finback now is called *B. physalus*), Bryde's whale was distinguished from the sei whale only in 1913, and arguments over the exact species of various individual whales go on endlessly. The whalers, however, have little interest in the discussions. They lump Bryde's whale and the Minke whales in with the seis, and their concentration is

This humpback whale was photographed off the coast of Alaska; the light mist over the whale is all that remains of a recent spout, or "blow."



on harvesting them all.

The major hunting ground for the blue whale has been the waters of the Antarctic, where are found the krill on which the whale feeds. There are blues in northern waters as well, and like the right and other baleen whales, the animals migrate to warmer waters during the winter months. Whether some whales cross the Equator to go to the opposite pole has not been determined and possibly never will be, for the blue whale may soon cease to exist.

In the past 60 years, more than 325,000 blue whales have been killed in the Antarctic. From a peak of more than 25,000 in the 1930-31 season, the blue whale catch has dropped steadily—and in recent years precipitously. Today, it is believed that fewer than 1,000 blue whales may survive in the Antarctic, perhaps too few to allow the species to survive.

The same grim story can be told of the humpback whale. These animals, which run to 50 feet in length, used to be seen frequently in coastal waters from Europe to Australia. They seem to be playful beasts, and sailors have reported seeing humpbacks slapping each other sportively. Despite the fact that the humpback is now protected throughout the Pacific Ocean and south of the Equator in other oceans, it is feared that too few survive to perpetuate the species.

Whalers have sought out and slaughtered the largest whales first, so as the number of larger species declines, the killing of smaller whales increases proportionately. As the blue whale kill fell throughout the 1950's, the number of finbacks taken each year went up; for several years, more than 25,000 finbacks were taken annually. This was inevitable, since the migration patterns of the blues and the finbacks are very similar, and a blue whale sometimes even joins a finback school. And just as inevitably, the finback population has dropped because of overhunting. With all their efforts, the whalers could catch fewer than 2,500 finbacks in the 1965-66 season.

The same is true of the sei whale, so called because it appears off the Norwegian coast at the same time as the seje fish. Experts have estimated that the total sei population was never more than 60,000, yet the sei catch has averaged about 5,000 annually during the 1960's.

In pursuing their course of apparent self-destruction, the members of the whaling industry are in the ironic position of ignoring advice given by a panel of experts appointed by the whaling industry.

The agency charged with supervising the whaling industry is the International Whaling Commission, which went into operation in 1948. But since the commission has no inspection powers and cannot enforce its recommendations, it can do nothing to insure that enough whales are left alive to keep the industry in existence. The whalers themselves show no interest in following the recommendations.

For instance, in 1963 the commission received a special report from a committee that had been set up three years earlier because of the growing concern about the diminished supply of whales. The three-man committee warned that only 40,000 finbacks remained and urged that the finback kill be limited to 5,000 annually. It said that no humpbacks or blues should be taken at all. And it predicted that even if the whalers went all-out for a maximum kill in the 1963-64 season, they would get no more than 8,500 blue-whale units, of which 14,000 would be finbacks. The recommendations and warnings were ignored—and the committee's predictions were fulfilled to the letter. Whalers killed 13,870 finbacks—8,429 blue-whale units. Had finback whaling been suspended for a few years, the species would have now developed a sizeable population.

Similar recommendations were made—and ignored—the next year, and the whaling catch fell even more. Finally, in 1965, the whalers agreed to some of the committee's suggestions. But even with this belated action, it appears to be too late for some species. It could take a century to restore the whale population to the levels that existed a decade ago.

Even with these clear lessons in front of them, the whalers appear ready to play out the same depressing scenario with one last whale—the sperm, the only great whale to survive in any numbers. The conservation committee, alarmed at the killing of 29,000 sperm whales in 1964, recommended a ban on hunting with factory ships in the seas between 40 degrees north latitude and 40 degrees south latitude. That recommendation was approved by the commission but ignored by Norway, Japan, and Russia, the only nations operating factory ships in that area. While the sperm whale kill dropped in 1965, it was not for lack of trying, and the drop reflects a dangerous decrease in the sperm whale population.

It would appear to be self-evident wisdom for the whalers to limit the sperm whale take to a level that would allow both the whale and the industry to survive. But on the basis of past experience, it must be feared that they will take the necessary steps only after it is already too late.

animal kingdom
NEWS OF ZOOS, AQUARIUMS, AND CONSERVATION
REPORTS

Laurance S. Rockefeller

Rockefeller N.Y.Z.S. President

Laurance S. Rockefeller has been elected president of the New York Zoological Society by the organization's board of trustees. Fairfield Osborn, president of the organization since 1940, has retired from his post. Announcement of the election was made December 13.

Mr. Rockefeller, a trustee of the society since 1936, was first vice-president from 1959 until his election to the organization's presidency. The New York Zoological Society operates the Bronx Zoo, New York Aquarium, the Osborn Laboratories of Marine Sciences, the William Beebe Tropical Research Station (in Trinidad), and the Institute for Research in Animal Behavior — the latter in partnership with the Rockefeller University.

Robert G. Goelet has been elected executive vice-president and chairman of the zoological society's executive committee.

Henry Clay Frick II, Howard Phipps, Jr., and John Pierrepont have been re-elected vice-president, secretary, and treasurer, respectively. Dr. Osborn will continue as a society officer as chairman of the board of trustees.

Dr. Osborn became a trustee of the zoological society in 1923 and from 1935 to 1940 served as its full-time secretary. For decades he has been an eloquent spokesman for conservation of natural resources. He gained worldwide recognition for his first book, *Our Plundered Planet*, which made many people aware for the first time of the wanton destruction of the earth's natural resources and of the impending crisis of over-population.

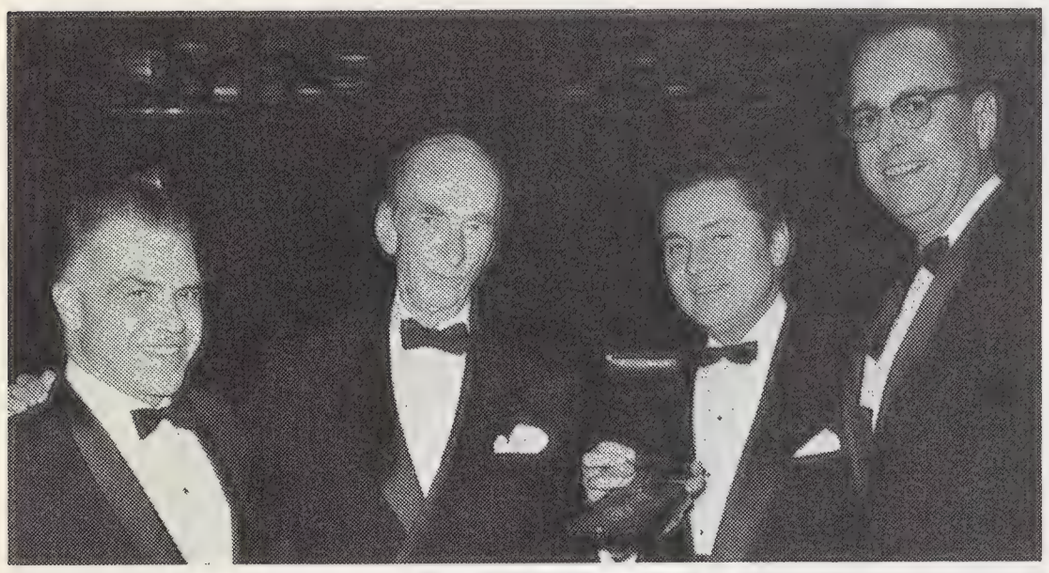
First published in 1948, *Our Plundered Planet* is in its twenty-fourth printing. It has been hailed as a prophetic book for its time.

The earth's wildlife resources have drawn particular attention from Dr. Osborn, who has been especially active in the effort to prevent extinction of threatened species.

Like Dr. Osborn, Mr. Rockefeller has long been a leader in conservation efforts. He is chairman of the President's Citizens Advisory Committee on Recreation and Natural Beauty and of the New York State Council of Parks and Outdoor Recreation. Mr. Rockefeller is a trustee and president of the American Conservation Association, which he established in 1958 to advance, improve, and

encourage knowledge and understanding of conservation, to preserve, protect, and restore the beauties of the landscape, and to educate the public in regard to the proper use of such areas.

Mr. Rockefeller has worked closely with Dr. Osborn in behalf of the New York Zoological Society and its institutions.



Dr. Fairfield Osborn, then president and now chairman of the board of trustees of the New York Zoological Society, is shown above (second from left) after receiving the Audubon Medal at the National Audubon Society's annual dinner in New York City on November 12. With Dr. Osborn are (from left to right) Charles H. Callison, executive vice president, Dr. Elvis J. Stahr, president, and Gene W. Setzer, chairman of the board of directors, all of the National Audubon Society.

Trumpeters on the Comback Trail

The trumpeter swan, once threatened with extinction, has now increased in number to the point where the U.S. Government has removed the species from the official list of rare and endangered animals.

After the 1968 fall aerial survey, biologists of the Interior Department's Bureau of Sports Fisheries and Wildlife concluded that the total population is now 4,000 to 5,000 birds.

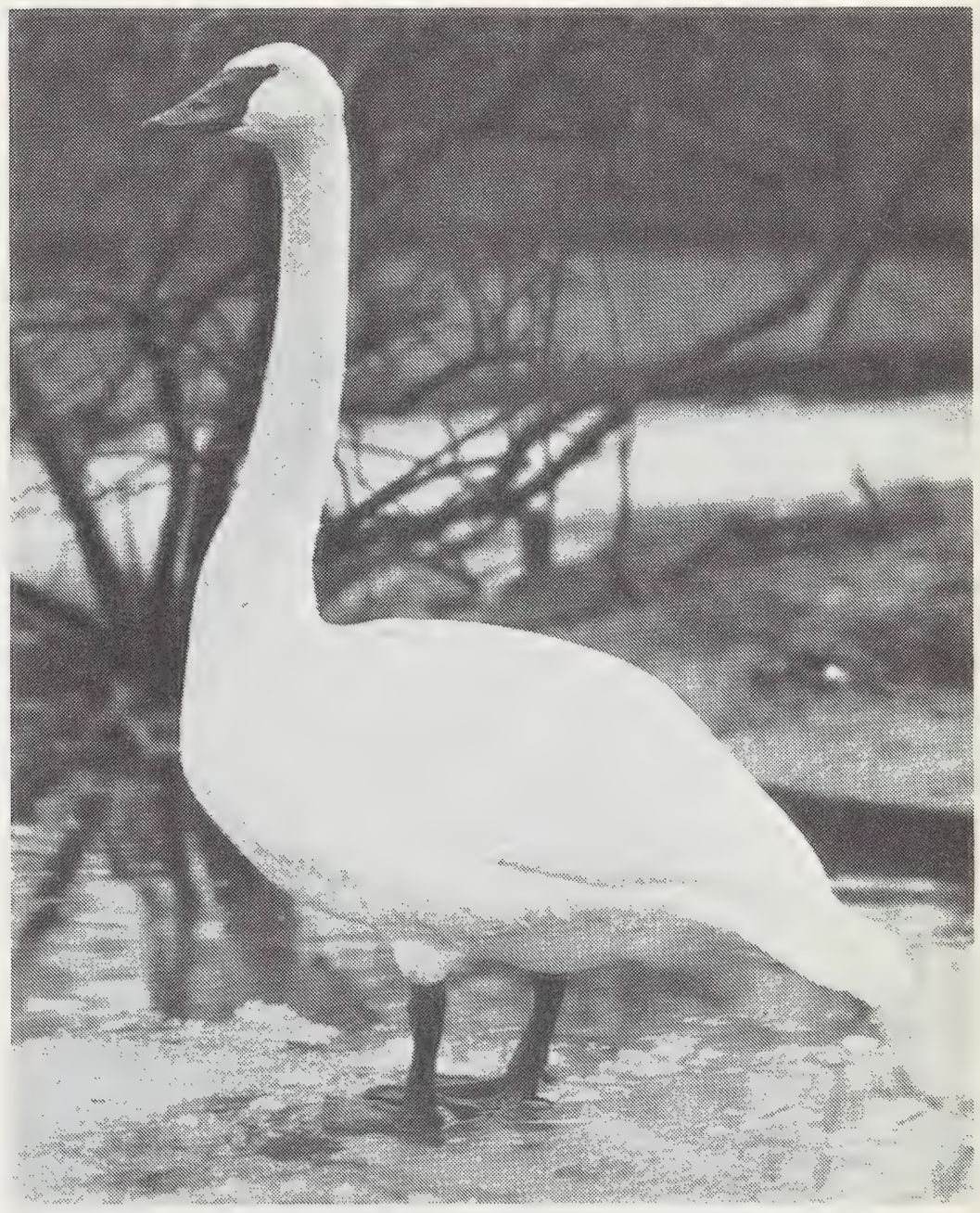
The trumpeter is the largest swan and one of the heaviest of all flying birds. Male trumpeters sometimes reach a weight of 30 pounds.

Once ranging over most of central and western North America, the birds were hunted for their plumage to decorate women's hats and for meat. In 1935, the trumpeters numbered only 73 in the United States outside of Alaska; these were confined to a 60-square-mile area around Yellowstone National Park.

The increase in the species has been attributed to a successful conservation program, which has included transplanting the trumpeters to national wildlife refuges in the Rocky Mountains area. Recently the first transplant east of the Rockies was accomplished successfully at Lacreek National Wildlife Refuge in South Dakota.

The conservation program also included lending the birds to zoos for breeding, with the Government retaining title to the trumpeters and any offspring. About 50 zoos have 80 or more birds in captivity.

The bureau plans to continue to monitor the swan populations, according to bureau director John W. Gottschalk. "And," he said, "we intend to increase our efforts to restore trumpeters to appropriate parts of their former breeding range."



The trumpeter swan *(Cygnus buccinator)*, largest of the swans, is pure white, with heavy black feet and bill.

Pollution Fish Kill Report Released

Identifiable pollution sources killed a total of 11,591,000 fish, in 40 states during 1967. This represents an increase of 21 percent over 1966.

The annual fish kill report is compiled and published by the Federal Water Pollution Control Administration of the Department of the Interior from information received from state agencies.

Industrial pollution was responsible for 71 percent of the total number of fish killed. Pollution from farming practices, with 16 percent, was second, and waste from cities placed third.

One fish kill, at Webster City, Iowa, accounted for more than half of the fish killed last year. A valve failed in a frozen food plant releasing 600 gallons of ammonia into the river. This killed 6,549,200 fish, mostly minnows, in a six-to-seven mile stretch of the Boone River.

Most fish kills are the result of mechanical failures, accidents, ignorance, or human carelessness. But in 10 instances last year, the pollution was reportedly deliberate.

Wild Wolves Sighted

Yellowstone National Park reported the sighting of at least six wolves during the past year. Wolves were believed exterminated in the area and are rare throughout the United States.

Park officials told *Animal Kingdom* they are hopeful that the wolves are in Yellowstone to stay and will increase. In addition to providing tourists with the chance to see a wild wolf, the animals may help to maintain the balance of nature, according to park superintendent Jack K. Anderson. All wildlife in the park is protected from hunters, and elk herds, for example, tend to outgrow the available forage.

THE bookshelf

A FIELD GUIDE TO THE NATIONAL PARKS OF EAST AFRICA. *By John G. Williams. Illustrated by Rena Fennessy. 352 pp., 16 color plates and 16 black-and-white plates. Houghton Mifflin Company, Boston, 1968. $8.50.*

This book would immeasurably increase the benefits derived from travel in Africa. It is an adequate tour guide but its chief delight to many *Animal Kingdom* readers will be the animal checklists and field guides, which are every bit as meaningful to the would-be African traveler as to those fortunate enough to actually go.

The field guides to mammals and birds follow the Roger Tory Peterson system with an illustration and a discussion of each species, including identification, distribution, and habitat.

Hugh B. House

THE PICTORIAL ENCYCLOPEDIA OF BIRDS. *By J. Hanzak. Edited by Bruce Campbell. 582 pp., over 1,100 photographs, 45 color plates. Crown Publishers, Inc., New York, 1968. $10.00.*

This ambitious volume sets out to depict photographically as many bird families, genera, and species as possible under one cover. The results are uneven for several reasons. While there are 45 full-color plates, most of the birds are pictured in black-and-white, conveying little to the person unfamiliar with the species involved. Added to this, many of the photos are admittedly of mounted specimens. This is particularly disturbing when the pictures are misleading. The bellbirds on pages 408 and 410 are a case in point, for both are old mountings showing the birds' wattles in erect, unnatural positions. In direct contrast, many other photographs, like those of young titmice in the nest (pp. 442 and 446), are charming and unusual. The text accompanying the photos on each page is a secondary feature, brief and giving little more than a description of the birds' color, range, and taxonomic position.

J. Bell

THE BOOK OF THE GIRAFFE. *By C. A. Spinage. 191 pp., 50 drawings and photographs, 3 maps. Houghton Mifflin Company, Boston, 1968. $6.95.*

It seems curious, considering the truly impressive characteristics of the "admirablest and fairest beast," that no previous book, at least in English, appears to have been devoted, basically, to the giraffe. Its great height, which may be as much as 18 feet, its attractive markings, and perhaps, above all, the fact that it still survives in its rapidly restricting world, make it a subject long in need of an author. Not that sketchy accounts and illustrations, often fanciful, have not appeared from very early times. Mr. Spinage has done a thorough job, reviewing the ancestry of the giraffe, its history in primitive art, early reports and descriptions of the living animal, and winding up with his experiences of the animal in the field. An appendix gives an all-too-brief account of the giraffe's close relative, the okapi. The illustrations include reproductions of ancient cave drawings, fascinating attempts to figure an animal seldom actually seen by the artist, and some superb photographs made by the author himself. Little that is known about the giraffe is missing here.

L.S.C.

BRITISH BIVALVE SEASHELLS. *By Norman Tebble. 212 pp. The British Museum (Natural History), London, 1966. $4.00 (incl. postage).*

This book is intended to be used as a guide to the Lamellibranch molluscs (bivalves) found in the seas around the British Isles. Following some general statements concerning the classification of molluscs, the basic ecology, and diagnostic features of bivalves, the text proceeds, by means of a dichotomous key, to detailed considerations of most of the representative species of 23 superfamilies of the class Lamellibranchiata. Numerous color and black-and-white photographs as well as many line drawings further facilitate the identification of British bivalves. An attractive color jacket folds around the sturdy cover of this hardbound book. Its small format (about 5 x 7½ inches) makes it convenient to use in the field. There is an inch and centimeter scale printed on the inside of the back cover for aid in identifying the seashells.

Despite these conveniences, the book unfortunately has some serious shortcomings. First, and most important of all, it does not fulfill the stated objective of being an aid to "anyone beginning a study of seashells or marine life." Although a detailed and elaborate glossary is provided, only a person with substantial knowledge of the biology of molluscs would be able to use this book effectively. The major obstacle here lies in the various keys for superfamilies, families, genera, and species. The functions of a dichotomous key (which is inherently difficult to use even by someone with an adequate knowledge of the subject matter) and the technique involved in using it effectively are not explained at all.

Other weaknesses of this book are to be found in its general layout and within the organization of the material provided. The section on diagnostic features of bivalves should have had all the terms it explains, either in italics or bold print for better recognition. For quick reference the literature section and the glossary belong at the end of a book, *not* in the middle! The paragraph headings among the superfamilies and families are poorly identified and preferably should have coincided with the beginning, not the middle, of a page; thus the "crammed" appearance of this book could have been avoided.

The preceding points, although of minor consequence to the actual content of the book, are of paramount importance to the effectiveness and usefulness of an identification handbook. Yet, despite these objections, this book does offer a wealth of information and thus can be of considerable help to the experienced conchologist or marine biologist as a field or laboratory guide.

U. Erich Friese

THE MOON OF THE MOUNTAIN LIONS. *By Jean Craighead George. Illustrated in black-and-white by Winifred Lubell. 42 pp. Thos. Y. Crowell Co., New York, 1968. $3.75.*

THE MOON OF THE WILD PIGS. *By Jean Craighead George. Illustrated in black-and-white by Peter Parnall. 42 pp. Thos. Y. Crowell Co., New York, 1968. $3.75.*

Latest in the series of children's books in the nature series, The Thirteen Moons, these two small volumes measure well up to the standard of those that have preceded them. Mrs. George writes in a simple but informative style, well-suited to arousing in children an interest in the animal life of various sections of this country. The profuse illustrations aid greatly in clear understanding.

L. S. C.

ABOUT THE authors

Robert Brandner is a keeper in the Bronx Zoo's Department of Herpetology. **Joseph A. Davis, Jr.**, is scientific assistant to the director of the New York Zoological Park. **Edward Edelson** is a science writer whose work appears often in *Animal Kingdom.* **Antony Gahan,** based in New York, is a writer who has worked with scientists for many years. **William Meng** is a photographer for the New York Zoological Society.

ILLUSTRATION CREDITS

Front Cover – N.Y.Z.S., William Meng; pp. 2-3 – Robert Brandner; p. 5 (drawing) – Joseph A. Davis, Jr.; pp. 5, 7 – Robert Brandner; pp. 10-12 – N.Y.Z.S., Joseph A. Davis, Jr.; pp. 13-15 – N.Y.Z.S., William Meng; pp. 16-19, 21 – Collection of Dr. Theodore C. Schneirla; p. 22 – Mitchell Campbell from National Audubon Society; p. 25 – Karl W. Kenyon from National Audubon Society; p. 27 – Arnold Newman; p.28 – Manny Greenhaus, and N.Y.Z.S.; Back Cover – N.Y.Z.S., William Meng.

Contents 1968

No. 1. FEBRUARY

The Wreck of the Torrey Canyon — Epilogue . . . . . *Alison Jolly* 4
New Guinea's Pint-size Parrot . . . . . *George Lippert* 14
Cat of the Pharoahs — The African Wild Cat from Past to Present . . *Reay H. N. Smithers* 16
Strangest Limb on Man's Family Tree . . . . *Stan Federman* 24
John Tee-Van — A Memorial Article . . . . *Fairfield Osborn* 30
Animal Kingdom Reports 32
The Bookshelf 34
About the Authors 34
Illustration Credits 34

No. 2. APRIL

Adventures and Misadventures of the Green Turtle: Part I — Misadventures . . *William J. Cromie* 4
Duck Displays . *Jack and Inger Bradbury* 12
Barrabea — A Mammal that Hatches . . . . . *John Hillaby* 20
An Ordered Society — Life in a Macaque Troupe . . *Stan Federman* 22
Florida's Diamondback Holds Its Ground . . *William M. Partington* 28
Animal Kingdom Reports 30
The Bookshelf 33
About the Authors 34
Illustration Credits 34

No. 3. JUNE

The Cotingas — A Study in Contrasts . . . *Alexander F. Skutch* 4
Nectar Feeding Bats . *Photographs by Dominic Crolla* 10
Adventures and Misadventures of the Green Turtle: Part II — Adventures . . . *William J. Cromie* 13
The Consumption of Wildlife by Man . . . . *William G. Conway* 18
Expedition Sea Otter . . *C. Jack Barton* 24
The Dance of the Bees . *Edward Edelson* 28
Animal Kingdom Reports 33
About the Authors 34
Illustration Credits 34

No. 4. AUGUST

Ora — Giants of Komodo . *F. Wayne King* 2
Snake Venom . . . . . *N. J. Russell* 10
Genetic Phenomenon, the Formosa Molly . . *Klaus D. Kallman* 13
The Montreal Aquarium . *Arthur Fisher* 20
Lee S. Crandall — 60 Years at the Bronx Zoo 24
Delicate Operation on Pachyderm *Photographs by Sam Dunton* 26
Animal Kingdom Reports 28
The Bookshelf 31
About the Authors 32
Illustration Credits 32

No. 5. OCTOBER

River Otters, Sea Otters, and Part-time Otters (Part I) . . . *Joseph A. Davis, Jr.* 2
British Columbia's Sea Bird Islands . . . . *David Hancock* 8
Zoo Portraits *Photographs by Paul G. Kovac* 14
Roundup On the Bison Range . . . . . *Stan Federman* 18
T'o . . . . . *Peter Brazaitis* 24
Animal Kingdom Reports 28
The Bookshelf 31
About the Authors 32
Illustration Credits 32

No. 6. DECEMBER

Wilderness Island in Megalopolis — The Pine Barrens . *Robert Brandner* 2
River Otters, Sea Otters, and Part-time Otters (Part II) . . . *Joseph A. Davis, Jr.* 8
Close-up on the Birds of Prey *Photographs by William Meng* 13
Ant Armies of Tropical America . . . . . *Antony Gahan* 16
"So Remorseless a Havoc"— Can the Great Whales Survive? . . . . *Edward Edelson* 22
Animal Kingdom Reports 27
The Bookshelf 29
About the Authors 30
Illustration Credits 30
Contents 1968 31
Index 1968 32

Index 1968

Figures in **bold type** indicate that the reference is to, or includes, an illustration, map, or design.

A

alligator, American, 5:24
  Chinese, 5:24-27
Alligator
  mississippiensis, 5:24
  sinensis, 5:24-27
angelfish
  imperial, **back cover 4**
Anser canagicus, 5:16
ant, army, 6:16-21
  leaf cutting, 6:4
anteaters, spiny, 2:20-22
Aonyx, 5:3-4, 6:8-9, 10, 12
Apis dorsata, 3:30
  florea, 3:30
  mellifera carnica, 3:30
  mellifera lugustica, 3:30
Asian water dragon, 5:15
Atta septentrionalis, 6:4
attendance, 150-millionth visitor to Bronx Zoo, 4:28
auklet, 5:12
  rhinoceros, 5:13

B

Balaenoptera musculus, 6:25
  physalus, 6:25
Balaenopteridae, 6:22, 25
Barton, C. Jack
  "Expedition Sea Otter," 3:24-27
bats, long-nose, 3:10-12
bears, new exhibit opened at Bronx Zoo, 5:28
Beebe, William, 3:33
bees, black Austrian honeybee, 3:30
  "dance of the bees," 3:28-32
  giant bee, 3:30
  honeycomb, 3:31
  Indian dwarf bee, 3:30
  Italian honeybee, 3:30
  Meliponini (stingless), 3:32
  nest of honeybees, 3:29
birds of prey, 6:13-15
bison, American, 5:18-23
Bitis arietans, 4:11, 12
Books reviewed:
  "Animal Ecology in Tropical Africa," 2:33
  "Animal Vision," 5:31
  "Birds of America," 2:24
  "The Book of the Giraffe," 6:29
  "British Bivalve Seashells," 6:30
  "A Dead Whale or a Stove Boat," 2:33
  "A Field Guide to the Birds," 5:31
  "A Field Guide to the Mammals of Britain and Europe," 5:31
  "A Field Guide to the National Parks of East Africa," 6:29
  "The Fishes," 4:32
  "Four-legged Australians," 1:34
  "Instinct and Intelligence, Behavior of Animals and Man," 5:31
  "The Larousse Encyclopedia of Animal Life," 2:34
  "The Moon of the Mountain Lions," 6:30
  "The Moon of the Wild Pigs," 6:30
  "Penguins," 4:31
  "Process and Pattern in Evolution," 4:32
  "The Pictorial Encyclopedia of Birds," 6:29
  "So Excellent a Fishe," 2:34
  "Song Birds of the World," 2:33
  "The World of the Ant," 4:32
  "The World of the Frog and Toad," 4:32
  "World of the Great White Heron," 4:31
Bradbury, Jack and Inger
  "Duck Displays," 2:12-19
Brandner, Robert
  "Wilderness Island in Megalopolis — The Pine Barrens," 6:2-7
Brazaitis, Peter
  "T'o," 5:24-27
Bubulcus ibis ibis, 5:14
Buteo fuscescens australis, 5:15
butterflyfish
  longnose, **back cover 4**
buzzard, European, 6:15

C

Cachalot, 6:24
caracara, 6:14
Carpodectes, 3:5
cat, African wild, 1:16-23
  Egyptian statue of, **cover 1**
  swamp, 1:17
Cemophora coccinea copei, 6:7
Cephalopterus, 3:5
Ceratotherium simum simum, 5:14
Cetacea, 6:23
Chilean sea eagle, 5:15
Clemmys muhlenbergi, 6:6
Clethrionomys gapperi rhoadsi, 6:5
Colinus virginianus ridgwayi, 1:32
condor, California, 6:15
Conway, William G.
  "The Consumption of Wildlife by Man," 3:18-23
cormorant, double-crested, 5:11
  guanay, 5:17
Cotinga, 3:15
cotingas, 3:4-9
  bellbird, 3:5
  capuchin bird, 3:5, 9
  glossy blue, 3:5
  long-wattled, 3:4
  masked tityra, 3:6-8
  rufous piha, 3:8-9
  snowy, 3:5
  three-wattled, 3:6
  umbrella bird, 3:5
  white-winged becard, 3:8
Crandall, Lee S.
  "60 Years at the Bronx Zoo," 4:24-25
Crolla, Dominic
  photographs by, 3:10-12
Cromie, William J.
  "Adventures and Misadventures of the Green Turtle," Part I, 2:4-11 Part II, 3:13-17
Crotalus adamanteus, 2:28-29
  horridus horridus, 6:7
Cygnus buccinator, 2:15, 6:28

D

Davis, Joseph A., Jr.
  drawing by, 6:5
  map by, 5:7
  "River Otters, Sea Otters, and Part-time Otters," Part I, 5:2-7 Part II, 6:8-12
deer, white-tailed, 6:14
Dendroaspis angusticeps, 4:11
  jamesoni, 4:11, 12
  polylepis, 4:11
Dendrotettix quercus, 6:4
Dispholidus typus, 4:10
Doryline, 6:16-21
duck, displays, 2:12-19
  Argentine ruddy duck, 2:15, 18
  Bahama pintail, 2:16-17, 18, 19
  Barrow's goldeneye, 2:15
  Garganey teal, 2:18, 19
  goldeneye, 2:14
  Laysan teal, 2:15
  marbled teal, 2:18-19
  trumpeter swan, 2:15
Dunton, Sam, photographs by cover 3, 4:26-27

E

eagle, American bald, 6:15
  golden, 6:15
  monkey-eating, 6:15
  tawny, 6:14, 15
echidna, 2:20-22
Eciton, 6:16-21
Edelson, Edward
  "The Dance of the Bees," 3:28-32
  " 'So Remorseless a Havoc' — Can the Great Whales Survive?" 6:22-26
editorial by William G. Conway, 3:18-23
egret, cattle, 5:14
Elaphe guttata guttata, 6:7
elephants, African bush, **back cover 5**
Enhydra lutris, 3:24-27, 5:4, 5, 6:10-11
expedition to Ecuador, 5:29

F

falcon, peregrine, 6:14-15
falconry, 6:14
Federman, Stan
  "An Ordered Society — Life in a Macaque Troupe," 2:22-27
  "Roundup on the Bison Range," 5:18-23
  "Strangest Limb on Man's Family Tree," 1:24-29
Felis chaus, 1:17
  lybica, 1:16-23
Fisher, Arthur
  "The Montreal Aquarium," 4:20-23
Forcipiger lingirostris, **back cover 4**
Freiheit, Clayton F., 1:33
von Frisch, Karl, 3:28-32
frog, carpenter, 6:5, 6

G

Gahan, Antony
  "Ant Armies of Tropical America," 6:16-21
Geissel, Helga, 6:15

Goelet, Robert G., 6:27
goose, emperor, 5:16
Great White Heron Refuge, 2:32
guillemot, pigeon, 5:12
gull, glaucous-winged, 5:8, 10

H

Hancock, David
"British Columbia's Sea Bird Islands," 5:8-13
health warning, 5:30
Hillaby, John
"Barrabea — A Mammal That Hatches," 2:20-21
hippopotamus, pigmy, 5:28
Hydrictis maculicollis, 5:6
Hyla andersoni, 6:5, 6

I

iguana, common, 5:15
Iguana iguana, 5:15
International Whaling Commission, 6:26

J

jaguar, black, 5:30
Jocher, Ernst C. F., 6:14-15
Jolly, Alison
"Wreck of the Torrey Canyon — Epilogue," 1:3-13

K

Kallman, Klaus D.
"Genetic Phenomenon, the Formosa Molly," 4:13-19
King, F. Wayne
photograph by, front cover 4
"Ora — Giants of Komodo," 4:2-9
kite, Everglades, 6:15
red, **front cover 6**, 6:13
Kovac, Paul G.
photographs by, 5:14-17

L

leopard, African spotted, 5:17
snow, cubs, 4:30
Lipaugus unirufus, 3:8-9
Lippert, George
"New Guinea's Pint-size Parrot," 1:14-15
lizard, five-lined skink, 6:6
ground skink, 6:6
northern fence, 6:6
locust, post oak, 6:4
Lophura imperialis, 5:29
Loxodonta africana, **back cover 5**
Lutra canadensis, 5:3, 5-6
felina, 5:3, 6:11-12
lutra, 5:2, 3, 6
Lutrogale perspicillata, 6:12
Lygosoma laterale, 6:6

M

Macaca fuscata fuscata, 2:22-27
fuscata yakui, 2:24
macaque, Japanese, 2:22-27
McInnis, Frank G., 3:24
Meng, William, photographs by, 3:31, back cover 4, front cover 6, 6:13-15, back cover 6
Micropsitta bruijnii, 1:15
keiensis, 1:15
pusio, 1:15
Milvus milvus, **front cover 6**, 6:13
molly, formosa, 4:13-19
sailfin, 4:14
"sphenops molly," 4:14
monitor, Komodo, **front cover 4**, 4:2-9
monorail, at Philadelphia Zoo, 4:30
Montreal Aquarium, 4:20-23
mouse, red back, 6:5
murre, 5:10, 12
Mysticeti, 6:23

O

Odontoceti, 6:23
oil bird, 1:33
otters, 5:2-7, 6:8-12
Eurasian, 5:2, 3, 6
giant, 5:7
marine, 5:3, 6:11-12
North American (Canada), 5:3, 5-6
sea, 3:24-27, 5:4, 5, 6:10-11
small-clawed and clawless, 5:3-4, 6:8-9, 10, 12
smooth, 6:12
spot-necked, 5:6-7
Sumatran, 6:10
orangutan, twins, 2:30
Oregon Regional Primate Research Center, 1:25, 2:23
Osborn, Fairfield, 3:33, 6:27-28
awarded Audubon Medal, 6:28
"John Tee-Van — A Memorial Article," 1:30-31
oystercatcher, 5:12

P

pachyderm, operation on photographs of, 4:26-27
Pachyramphus polychopterus, 3:8
Panthera pardus, 5:17
parrot, pigmy, 1:14-15
Partington, William M.
"Florida's Diamondback Holds Its Ground," 2:28-29
Patuxent National Wildlife Center, 1:32
peacock, Congo, 2:32
Pediostibes hosei, **back cover 6**
Perissocephalus tricolor, 3:5, 9
petrel, 5:12
Phalacrocorax bougainvillii, 5:17
pheasant, imperial, 5:29
Physignathus cocincinus, 5:15
Pine Barrens, 6:2-7
bird life, 6:4
fish, 6:5
frogs, 6:5-6
insects, 6:4
lizards, 6:6
mammals, 6:4-5
plants, 6:4
salamanders, 6:6
snakes, 6:6-7
toads, 6:6
trees, 6:3-4
turtles, 6:6
Pituophis melanoleucus melanoleucus, 6:6-7
Poecilia formosa, 4:13-19
mexicana, 4:14
(Mollienesia) latipinna, 4:14
pollution, water, report on, 6:28-29
Pomacanthus imperator, **back cover 4**
Procnias, 3:5
prosimians, 1:24-29
angwantibo, 1:24
bug-eyed loris, 1:25
fulvous lemur, 1:29
galago, 1:24
lemur, 1:24
ring-tailed, 1:28
potto, 1:24
tarsier, 1:24
Przewalski horses, 2:32
Pseudotriton montanus montanus, 6:6
puffin, tufted, **front cover 5** 5:11
python, reticulated, 4:29

Q

quail, masked bobwhite, 1:32
Queens Zoo, opening, 5:28

R

rattlesnake, eastern diamondback, 2:28-29
pigmy, 2:29
timber, 6:7
rhinoceros, black, 4:30
Indian, 3:34
white, 5:14
river study, Indiana, 4:28
Rockefeller, Laurance S. elected president of NYZS, 6:27-28
Rorqual, 6:22, 25
Russell, N. J.
"Snake Venom," 4:10-12

S

salamander, eastern mud, 6:6
Sceloporus undulatus hyacinthus, 6:6
Schneirla, Dr. Theodore C., 6:18, 21
seal, northern fur, 5:30
Skutch, Alexander F.
"The Cotingas — A Study in Contrasts," 3:4-9
Smithers, Reay H. N.
"Cat of the Pharaohs — The African Wild Cat from Past to Present," 1:16-23
snake, corn, 6:7
northern pine, 6:6-7
scarlet, 6:7
snake venom, 4:10-12
boomslang, 4:10
carpet viper, 4:11
mamba, black, 4:11
green, 4:11, 12
puff adder, 4:11, 12
Stone, Walter, 5:29
swan, trumpeter, 2:15, 6:28

T

Tachyglossus, 2:20-22
takin, 3:31
Tee-Van, John, 1:30-31
Terrapene carolina carolina, 6:6
tiger, **cover 3**
Tityra semifasciata, 3:6-8
toad, climbing (female), **back cover 6**
Torrey Canyon, wreck of, 1:3-13
travel guide maps: inside back cover
Cleveland Zoo, 2
Columbus Zoological Gardens, 5
Oklahoma City Zoo, 1
San Francisco Zoological Gardens, 3
tree frog, Pine Barrens, 6:6
Triangle Island, B.C., Canada, 5:8
turtle, bog, 6:6
box, 6:6
green, **cover 2**, 2:4-11, 3:13-17

V

vulture, black (hooded), 6:15

W

whale, beluga, 2:31
blue, 6:23, 25-26
bowhead, or Greenland, 6:24
Bryde's, 6:25
finback, 6:23, 25, 26
gray, 6:24
humpback, 6:23, 25, 26
killer, 3:33, 5:30
Minke, 6:25
right, 6:24
sei, 6:25, 26
sperm, 6:23, 24, 26
wildlife appropriations, 4:29
wolf, 6:29
wood vole, New Jersey, 6:5

Z

zebra, Grevy's, 5:28

SMITHSONIAN INSTITUTION LIBRARIES

SMITHSONIAN INSTITUTION LIBRARIES

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 01261 4202